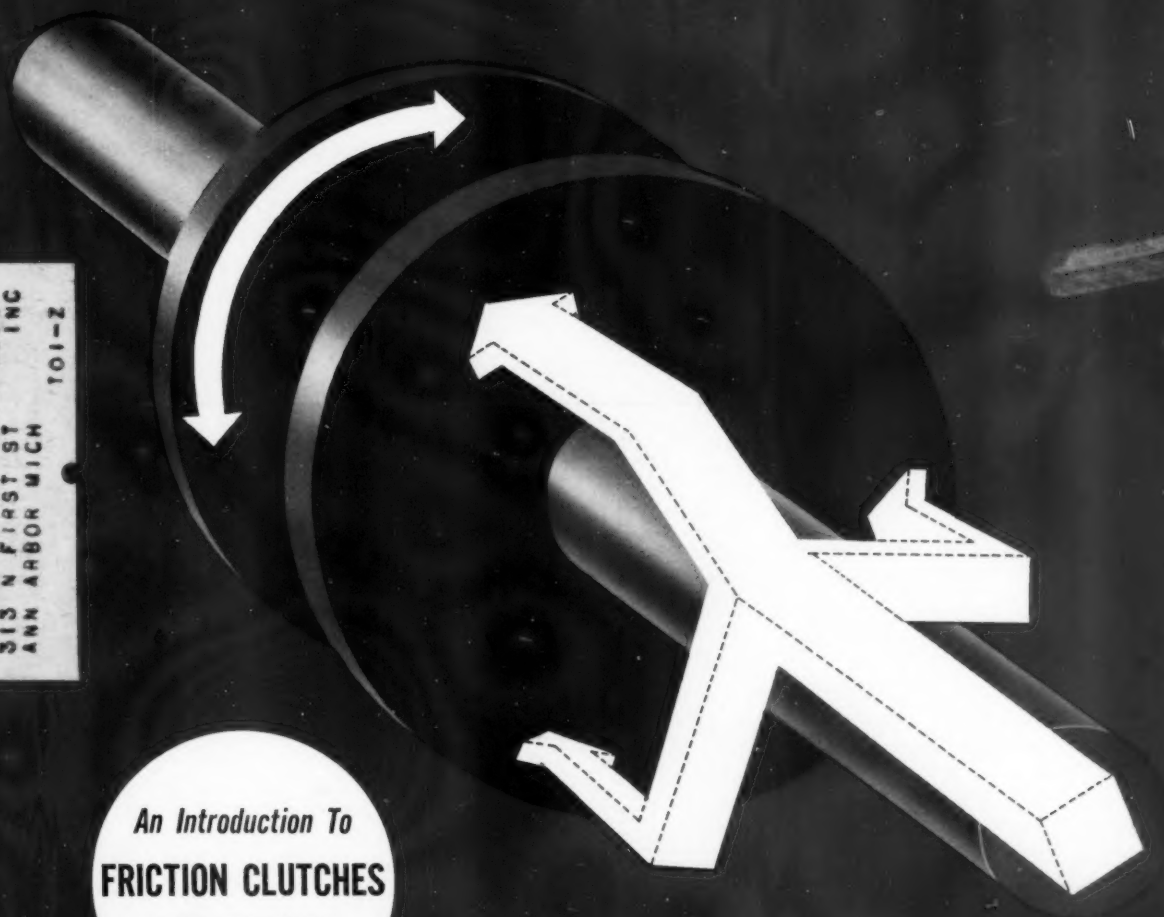
POWER TRANSMISSION DESIGN

JUNE 1960

OEM··MAINTENANCE



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An Introduction To
FRICTION CLUTCHES AND BRAKES

INCLUDING BEARINGS DESIGN/APPLICATION

ALSO IN THIS ISSUE:

Cruciform transmission flies VTOL craft

How to select grease for bearings

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SMOOTH—OPERATION

Manufacturers of the big diesel trucks, that must stand up under hour-after-hour of gruelling service, have learned to rely upon MECHANICS Roller Bearing UNIVERSAL JOINTS to deliver hundreds of thousands of miles of trouble-free service. Because MECHANICS JOINTS drive through KEYS—instead of bolts—they stand up under punishment that shears off other types of fasteners. They are designed with less parts and connections for easy assembly and servicing—smooth running balance—maximum strength with less weight—and long, trouble-free, safe operation. Rugged stamina is just one of the advantages you get when you specify MECHANICS Roller Bearing UNIVERSAL JOINTS. Let MECHANICS engineers help you design this and other competitive sales features into your product's transmission train.

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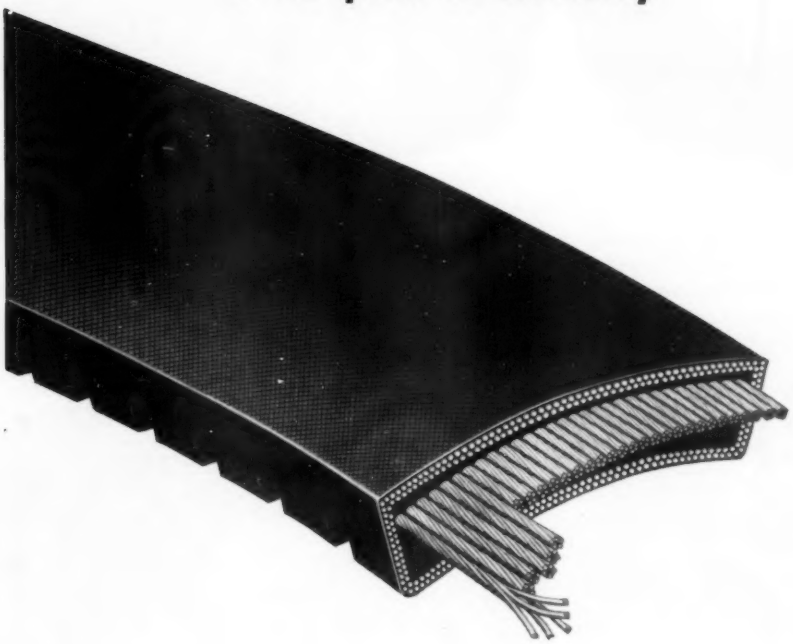

Through changing pitches, changing centers and changing speeds you can depend on a Maurey Variable Speed Belt for *unchanging dependability.* Rugged, triple tempered cords give it "muscle" for the heaviest load. A cushion of floating gum that shields the cords and keeps the belt cool makes for extra long service life. Uniformly notched undersides provide easy bending, without distortion. The shape of the belt and the abrasion resistant cover hold the sheave with a non-slip grip of positive power. Balanced Design puts these quality belt components in the precision proportions that assure uniformly long wear under severest working conditions. In addition, these belts are oil and heat resistant and static conductive. Get them from your Maurey Distributor. Write for Variable Speed Belt catalog No. VSB-1.

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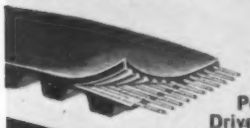
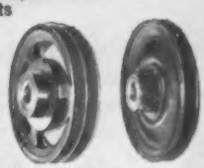


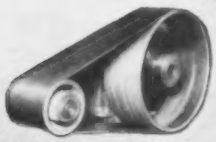
Positive Drive Belts

Variable Speed Belts

Mor-Grip V-Belts



Hi-Q FHP V-Pulleys



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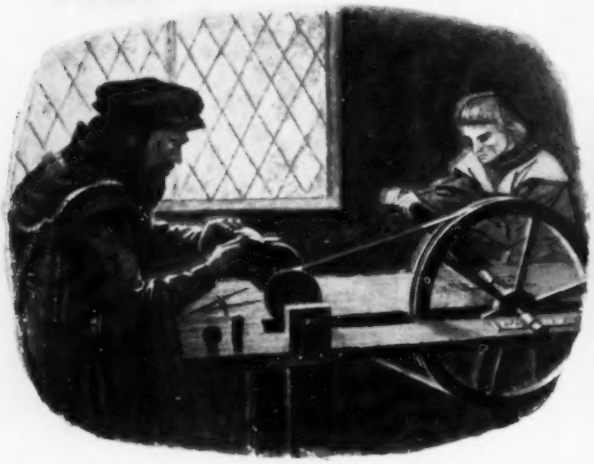
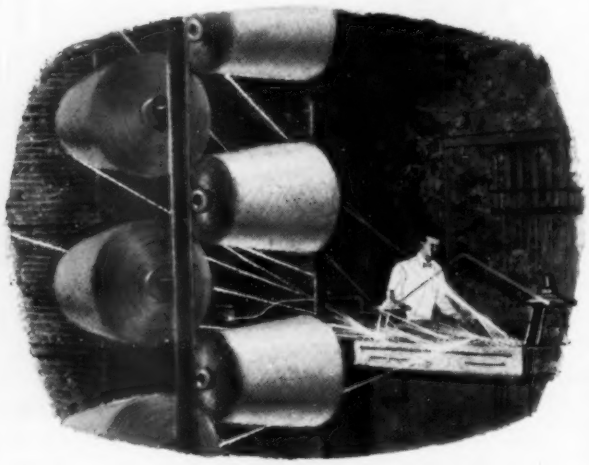
GOODYEAR EVOLUTION OF



IT ALL STARTED when Leonardo da Vinci invented the belt drive for his polishing wheel. Spurred on by the drive's many advantages, engineers have striven for a more effective method of indirect power transmission ever since.

THE NEXT MAJOR DEVELOPMENT, although then seemingly unrelated, was the discovery of the vulcanization of rubber in 1839. Charles Goodyear not only fathered a multibillion-dollar industry, but also helped pave the way to much more efficient power transmission.

ANOTHER MAJOR BREAKTHROUGH came in 1941, when Goodyear introduced the first practical Steel Cable V-Belt for use on Army tanks. Here was the strongest, most efficient, most heat- and stretch-resistant belt ever built. A wartime success, steel cable is used in belts handling today's toughest industrial drives.

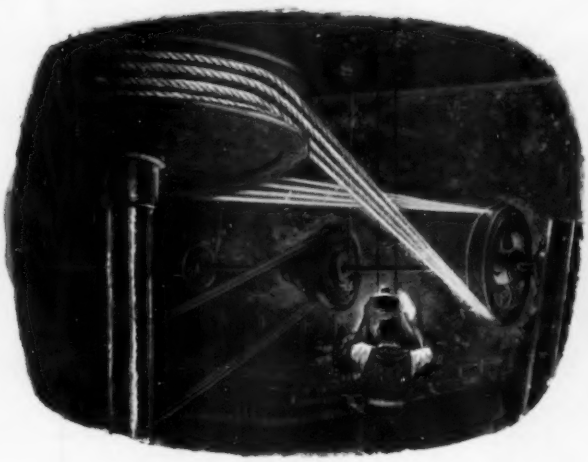


THEN CAME THE "MIRACLE" FIBERS and super-rated V-belts. Again Goodyear was in the fore with the HY-T V-Belt—a strong, shock-resistant belt that answered most multiple drive problems. But V-belt makers still sought a more effective way to overcome stretch and shrinkage.

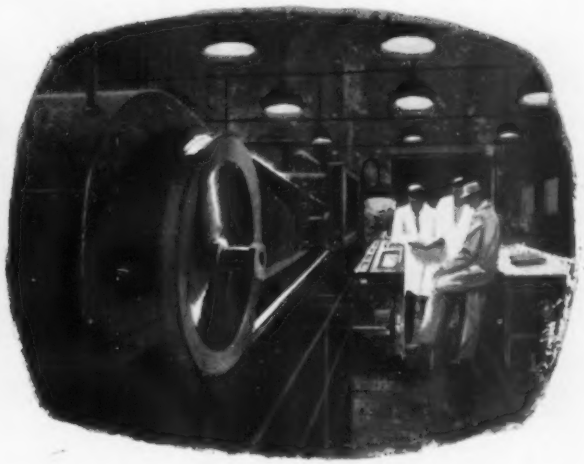
For maximum, trouble-free horsepower hours on any V-belt drive, insist on the top belt from the top beltmaker.

Lots of good things come from GOOD

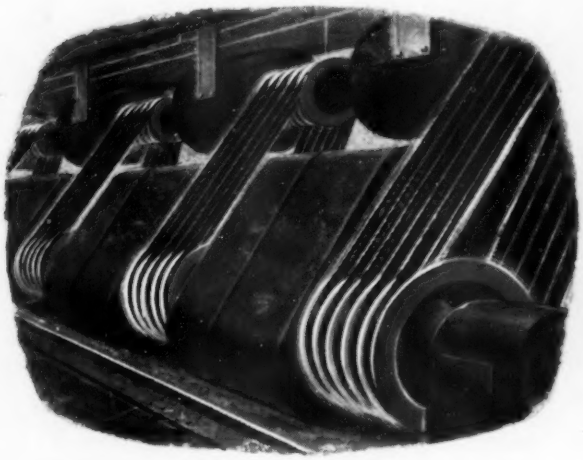
A REVOLUTION



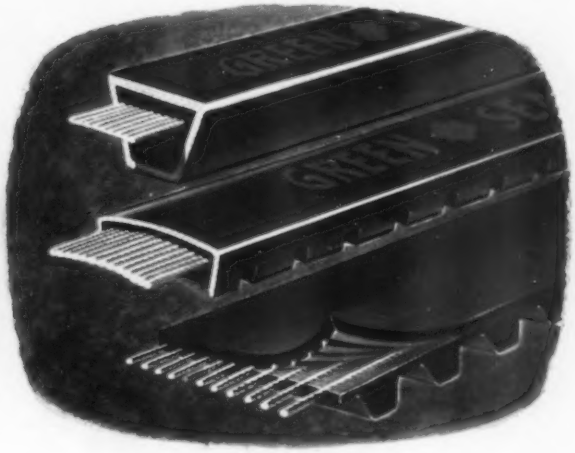
OVER A DECADE PASSED BEFORE a man named Combe introduced two new ideas in the transmission of power—teams of load-carriers and "wedge-in" action. His first multiple rope drive was not very efficient or durable, but started a whole new trend in development.



IT TOOK A LITTLE TIME before the first rubberized V-belts were introduced. Many of the earliest improvements were developed by Goodyear scientists. The greater efficiency of the V-belt soon placed it on many drives, despite shortcomings in length stability and strength.



GOODYEAR SOLVED THE PROBLEM with the 3-T Process to take surplus shrinkage and stretch out of synthetic cord. That development made possible multiple drive V-belts with true dimensional stability—Green Seal V-Belts by Goodyear that stayed matched on the drive or in storage.



A REVOLUTION IN POWER TRANSMISSION was launched by the complete line of V-belts with the Green Seal—Compass-V-Steel, HY-T, E-C Cord, and the compact new HY-T WEDGE. With P. D. (positive drive) and Variable Speed Belts, they combine to offer Goodyear belts of unsurpassed quality for every need.

See your Goodyear Distributor or write: Goodyear, Industrial Products Division, Lincoln 2, Nebraska, or Akron 16, Ohio.

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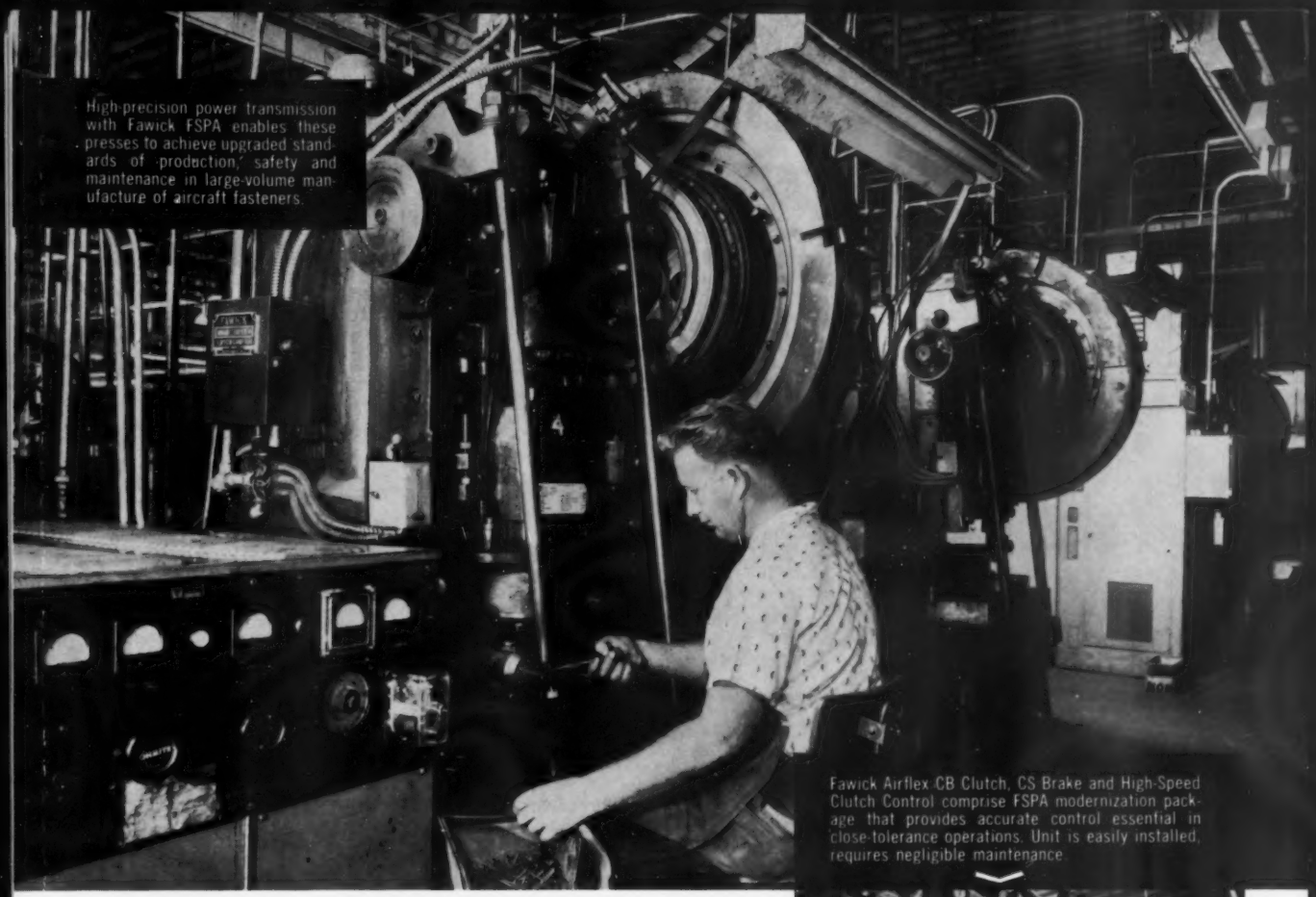
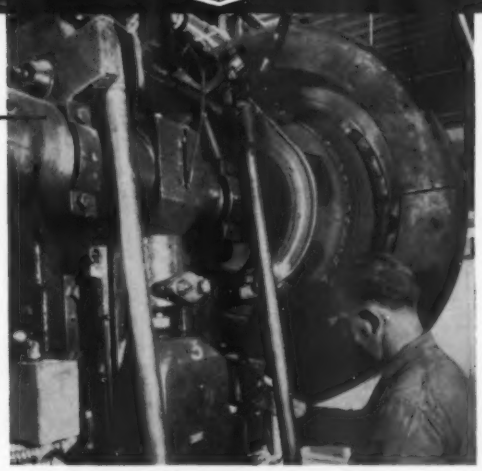


High-precision power transmission with Fawick FSPA enables these presses to achieve upgraded standards of production, safety and maintenance in large-volume manufacture of aircraft fasteners.

Fawick Airflex CB Clutch, CS Brake and High-Speed Clutch Control comprise FSPA modernization package that provides accurate control essential in close-tolerance operations. Unit is easily installed, requires negligible maintenance

FSPA (*Fawick Standardized Press Application*)

eliminates backlash, reduces tool and die wear!



FAWICK FSPA provides a valuable built-in operating advantage on cyclic machines by eliminating damaging backlash. This increases die life and machine precision—resulting in increased production and greatly reduced tool and die maintenance costs.

This has been "proved-by-performance" at Voi-Shan Manufacturing Company, Culver City, California, where high-precision fasteners for aircraft and missiles are produced by the million with FAWICK-equipped hot heading punch presses. Since modernizing their equipment with FAWICK Airflex Clutches and Brakes, Voi-Shan has increased machine productivity 20% while cutting maintenance costs 80%.

High efficiency performance of FAWICK air clutches and brakes has provided Voi-Shan with other important advantages over former mechanical clutches: Push-button power transmission with FSPA eliminates emphasis on manual skill. Set ups are easy, exact, and cycle timing is extremely precise. Close tolerances are easily maintained throughout long or short production runs.

This application is just one example how production profit dollars may be increased by putting your power transmission problems in FAWICK's capable hands. Call your nearest FAWICK representative or contact the Home Office, Cleveland, Ohio.

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INDUSTRIAL CLUTCHES AND BRAKES

Circle No. 17 on Reader Service Card

JUNE 1960

volume 2 number 6

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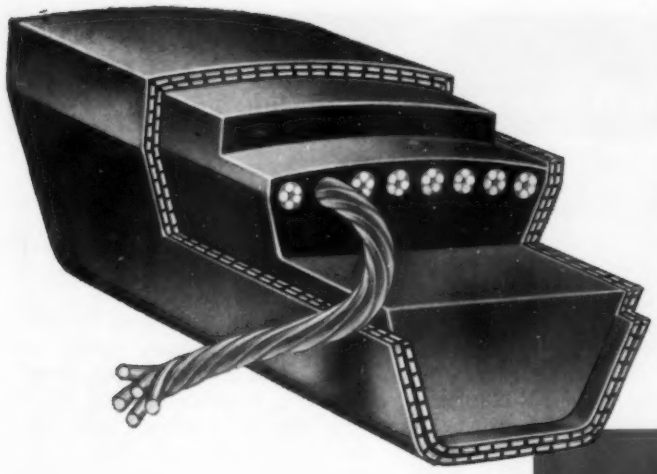

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DA 358 V-BELTS. This major design improvement in V-Belts brings you unprecedented compactness, high capacity and drive economy.

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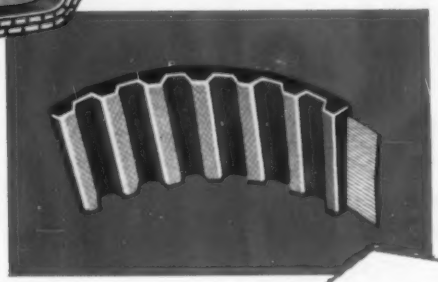
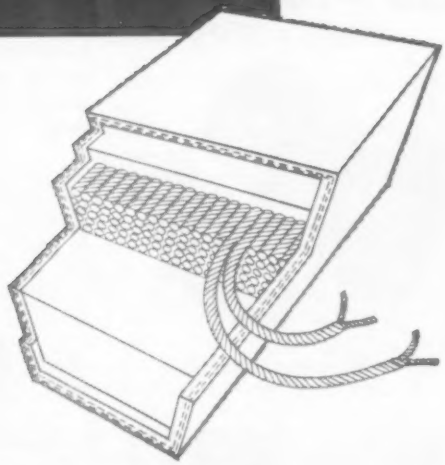
DA POSITIVE DRIVE BELTS. Revolutionary tooth-grip principle; no stretch; no constant lubrication. Highly versatile.



Whatever your V-Belt needs, DURKEE-ATWOOD *meets them*

What do you want in a V-Belt? You want consistent performance, long trouble-free life and full-rated power transmission. That means the belts must be made of the finest quality materials, with careful attention to engineering details, manufacturing processes and testing procedures. Durkee-Atwood V-Belts are made of the newest high tenacity synthetic fibres to assure length stability in storage. The exclusive Durkee-Atwood "Iso-Dynamic" Vertical Matching Machine eliminates the "sag error" that develops when V-Belts are matched on horizontal equipment. This assures equal power transmission from all belts on multiple drives . . . Look to Durkee-Atwood for *quality, service* and *savings ...the most complete line of industrial V-Belts.*

Look for the DA DURKEE ATWOOD LINKED-V BELTS *On Your V-Belts*



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RED SHIELD MULTIPLE V-BELTS. Increased capacity at no increased cost. Available in oil and heat resistant and static dissipating constructions.

Top Performance in Variable Speed Drives?

VARIABLE SPEED BELTS. For constant performance. Abrasion-resistant cover; crowned cross section maintains stability under extreme loads.

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NEWS *from the power transmission field*

Mammoth 75-ton rig works forward or backward

CHICAGO, ILL.—A 75-ton earthmover, designed and built by International Harvester's Construction Equipment Engineering Dept., is powered by two 375-hp diesel engines. A combination of two two-wheeled tractors joined back to back, it's believed to be the biggest vehicle of its kind.

Operating either forward or backward, it has a 14¼-ft, 8-ton dozer blade on the front unit and a 1-ft-thick pusher plate on the rear unit for pushing during scraping and loading. Although the PD-105 Pusher Dozer is 30 ft long with blade, it can turn inside a 24-ft radius.

With axles rigid to frame side members, the PD-105 bends in the middle where the tractor units are joined. Double-acting hydraulic cylinders on either side push in opposite directions to jackknife the rig. Each set of wheels in the articulated rig is powered by an 817-cu-in., 6-cylinder International engine. Transmissions are single-stage, torque converter driven, power-shift systems, providing 4 speeds forward and reverse. One range selector lever serves both transmissions. Another controls forward and reverse for both systems.

Seat, steering wheel, accelerators, and brakes are mounted on a turret which turns on roller bearings. To change directions, the operator kicks a release and spins the turret around. A switch, tripped by the turning turret, reverses oil flow in the steering system so the vehicle steers the same forward or backward.

The Pusher Dozer has a top speed of more than 21 mph, and 25 mph with optional high-speed gearing.

Plasma space engine passes 5-day test

FARMINGDALE, L. I.—What is claimed to be the only operating plasma space engine was demonstrated at a recent conference on ion and plasma propulsion sponsored by the Office of Scientific Research of the Air Force and Republic Aviation Corp.

Before the conference, the engine had been run continuously for more than 118 hours in Republic's Plasma Propulsion Laboratory, cycling 30 times a minute and using 3000 volts and 675 watts. The engine was shut down to examine the electrodes, and all equipment was found to be in good working condition. This was the first time scientists were able to achieve continuous cycling of the plasma "pinches" that give the engine its thrust.

The engine uses nitrogen for fuel and turns it into a plasma in which the molecules are broken into electrons and positive ions. The plasma is compressed or "pinched" by a cylindrical magnetic field until it is shot out of the compression chamber at tremendous velocities.

Dayton Rubber becomes Dayco Corp.

DAYTON, OHIO—Dayco Corp. is the new name of the Dayton Rubber Co. Because of the firm's diversification and growth, the original corporate name had lost most of its original descriptive meaning. In addition to rubber goods, the company makes chemicals, plastics, aircraft seating, and missile parts.

New engineering center

NEW YORK, N. Y.—A United Engineering Center, scheduled to be completed in mid-1961, will be occupied by 18 American engineering organizations with a combined membership of 300,000. The 20-story building, located between 47th and 48th St., is designed as a basic glass and stainless steel grid system with fixed windows, glass spandrels, and a masonry service core.

The building will be owned by United Engineering Trustees, composed of representatives of the American Society of Civil Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; American Society of Mechanical Engineers; American Institute of Electrical Engineers; and American Institute of Chemical Engineers.

Named A-C Houston rep.

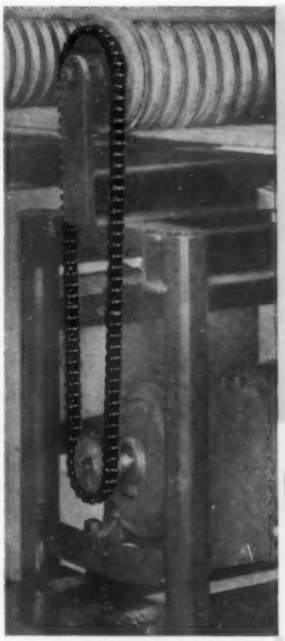
HOUSTON, TEX.—Brice Machinery and Controls Co. has been appointed sales representative by Allis-Chalmers for its industrial machinery and control equipment.

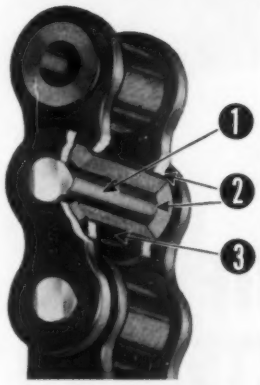
Western Gear expands

LYNWOOD, CALIF.—Western Gear Corp. has bought part of a former Navy shipyard at Everett, Wash., including its major manufacturing facilities. These facilities will be modernized and expanded at a cost of $500,000. The Seattle plant of the firm's industrial products division, which lies in the path of the Seattle-Tacoma Freeway, will be relocated there.

License Danish firm to make V-belt line

DAYTON, OHIO—Roulunds Fabriker, Ltd., of Odense, Denmark, has been licensed to make the complete line





Built-in Lubrication at these 3 Critical Areas

Critical Area 1:

PIN—Protective oil film lubricates live bearing area between pin and bushing, minimizing wear by reducing metal-to-metal contact.

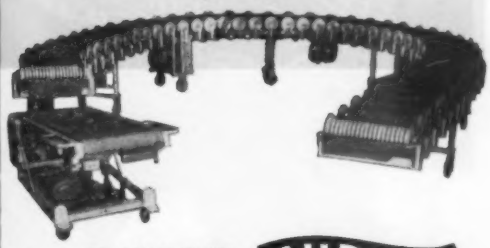
Critical Area 2:

PLATES—Oil-impregnated Sintered Steel Bushings extend beyond surface of inside plates to: act as lubricated thrust bearings, control clearance, and provide an oil cushion between plates, eliminating plate galling and seizing frequently caused by misalignment of sprockets.

Critical Area 3:

SPROCKET ENGAGEMENT—Oil film on MSL Bushing exterior provides constant lubrication between sprocket teeth and chain. Whitney MSL Chain requires no rollers, as the tough oil film on the bushing surface provides smooth sprocket engagement, cushions impact and reduces drive wear.

WHITNEY MSL*
SELF-LUBRICATING
CHAIN
Keeps Loads Rolling



For POWER-CURVE'S CONVEYORS

Power Curve's Bag and Package Loader works like a mechanical stevedore in high speed loading of box cars and trucks. The chain drives which shuttle and power this flexible conveyor must have plenty of stamina to withstand continuous shock loads from delivering chutes, and to propel loads in and out of cars.

To provide greater drive chain durability, Power-Curve engineers rely exclusively on Whitney MSL Self-Lubricating Chain.

The basic problem in chain operation has always been that more damage is caused by faulty chain lubrication at the 3 critical areas, than by years of normal service. Whitney Research has solved this problem through the development of a lubricated-for-life chain that outlasts ordinary chain as much as 5 to 1.

Oil-impregnated, Sintered Steel Bushings release a constant supply of lubricant under pressure and heat . . . re-absorb the oil when the drive stops . . . insure a permanent oil supply for the life of the chain.

For exceptional drive chain performance, long life, and for sure resistance to dust, dirt and other abrasives, specify and use Whitney MSL Chain. All essential dimensions conform fully to ASA Standards for complete interchangeability with any similar pitch chain.

Your Whitney Chain Distributor has a complete stock on hand, ready for immediate delivery. Consult him today.

*Maximum Service Life

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POWER TRANSMISSION DRIVES
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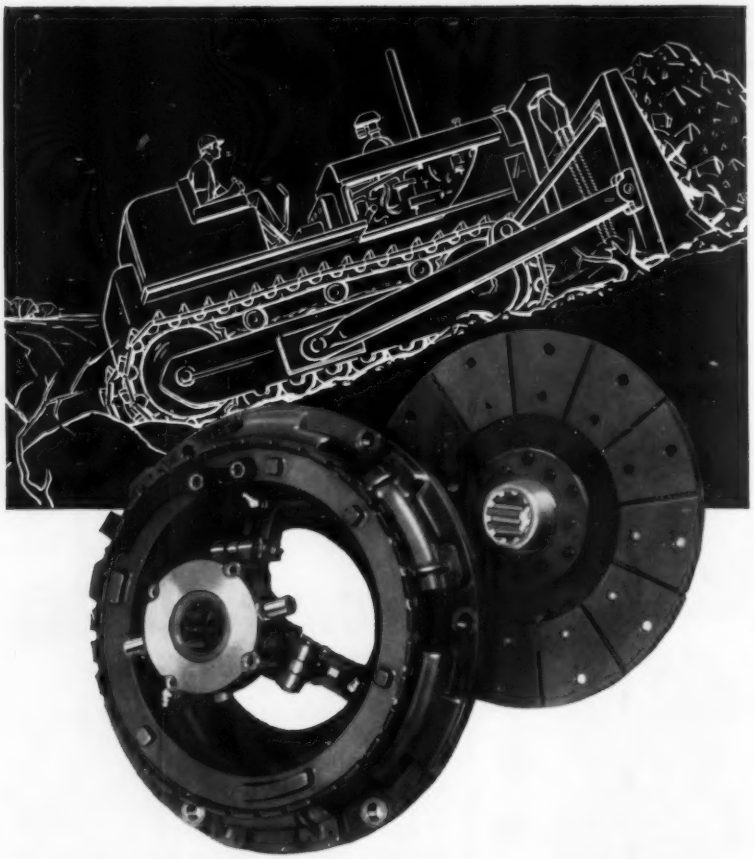
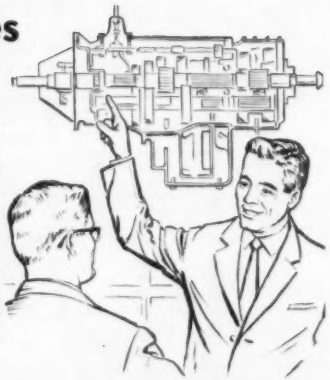


BETTER COMPONENTS... BETTER PRODUCTS!

Cooperation produces the final design

When each component part is the best, the whole machine is right. Rockford Over-Center Clutches are the finest made for crawlers, cranes and other heavy-duty equipment. If your equipment is in the design stage, let Rockford Clutch engineers help you select the best clutch. Rockford Clutches in standard sizes suit almost every need. Custom models can be designed for your applications. Call or write for the Rockford Clutch Catalog.



ROCKFORD CLUTCHES

ROCKFORD CLUTCH DIVISION BORG-WARNER

1331 EIGHTEENTH AVE.
ROCKFORD, ILLINOIS

Export Sales
Borg-Warner International
36 So. Wabash, Chicago, Ill.

Circle No. 32 on Reader Service Card

of Dayton V-belts and other products, says Dayton Rubber International, a division of Dayco Corp. The firm, founded in 1736, will market the products under the Dayton/Roulunds brand to Norway, Denmark, Sweden, Austria, Portugal, Switzerland, Finland, Iceland, and Great Britain.

To exhibit inventions

CLEVELAND, OHIO—The Cleveland Engineering Society will sponsor a National Inventions Exhibition and Creativity Conference at the Cleveland Engineering and Scientific Center June 20-24. Its purpose is to promote invention, research, and business by giving inventors and researchers a chance to get together with investors and industrialists.

New honing machine hones gears four ways

DETROIT, MICH.—Because successful honing depends so much on the method of developing work pressure between the honing tool and the work gear, National Broach & Machine Co. has designed a gear tooth honing machine that provides four separate honing methods.

Said to provide maximum operating versatility, they are:

- Honing with backlash, with a locked honing head.
- Zero-backlash operation with precision pressure control, with the honing lock.
- Constant pressure operation, with an automatic mechanical wedge-type back-up eliminator.
- Constant pressure operation,

with overload relief, with an adjustable leaf spring back-up protector.

The honer can handle gears up to 12-in. pitch diameter when loading is semi-automatic or manual. Gears up to 4-in. pitch diameter can be honed with automatic loaders. The machine has a 5-in. stroke and uses a 10-in. diameter honing tool.

Link-Belt opens new bearing plant

INDIANAPOLIS, IND.—Link-Belt Co. opened a new plant at 7601 Rockville Rd. for producing self-aligning ball bearings, spherical roller bearings, and roller bearing transmission units.

MPTEDA to meet

WASHINGTON, D. C.—The recently-organized Mechanical Power Transmission Equipment Distributors Association will hold its national convention Sept. 23-24 at the Pick Congress Hotel in Chicago.

MEETINGS

JUNE

5-10 Society of Automotive Engineers, Summer Meeting, Edgewater Beach Hotel, Chicago, Ill.

6-8 American Gear Manufacturers Association, 44th Annual Meeting, The Homestead, Hot Springs, Va.

SEPTEMBER

14-16 National Petroleum Association, Annual Meeting, Hotel Traymore, Atlantic City, N. J.

15-16 American Institute of Mining, Metallurgical, and Petroleum Engineers, Engineering Management Conference, Joint Committee, Morrison Hotel, Chicago, Ill.

OCTOBER

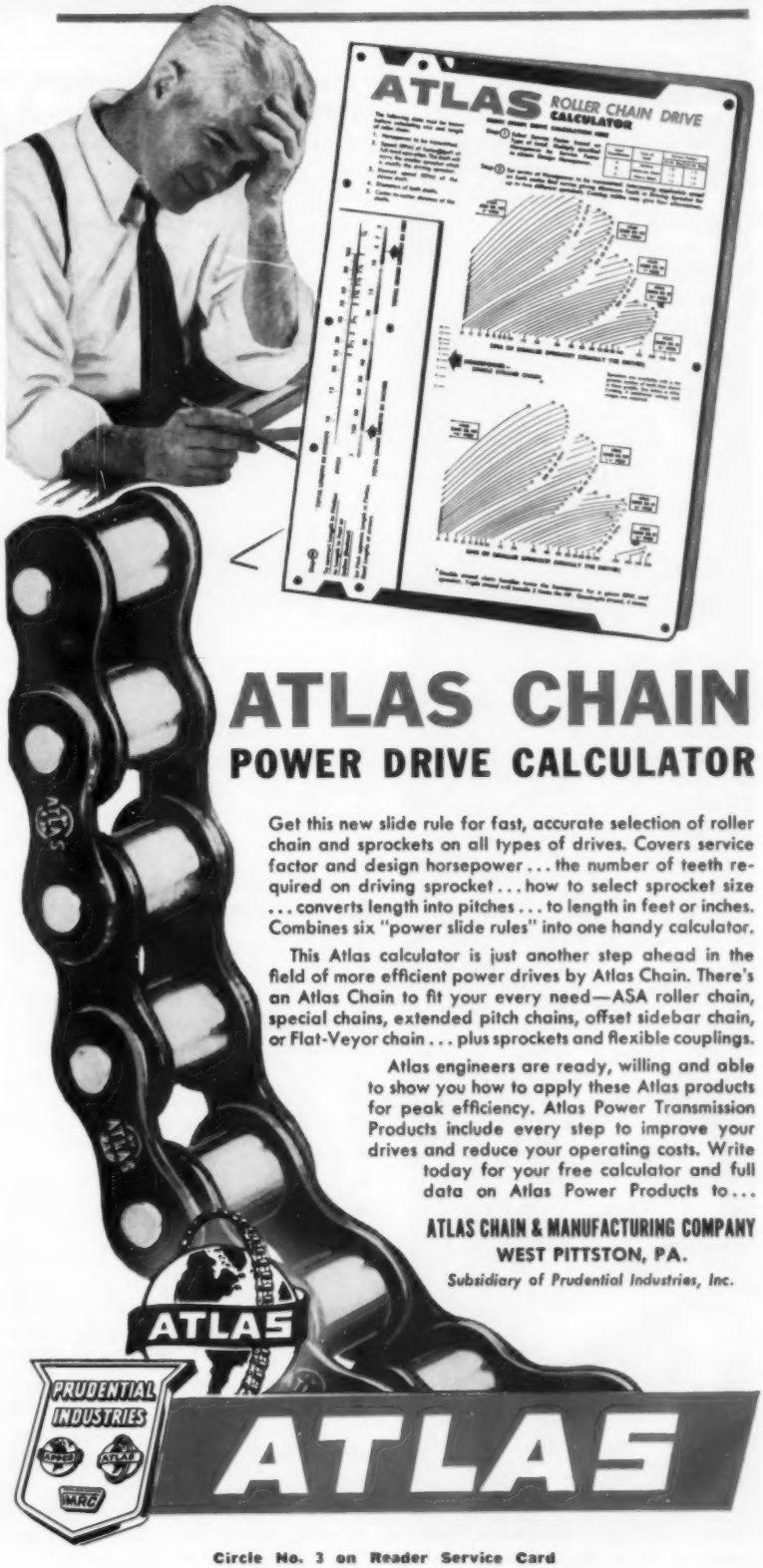
17-19 American Society of Mechanical Engineers-American Society of Lubrication Engineers, Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

30-Nov. 1 National Lubricating Grease Institute, Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

NOVEMBER

27-Dec. 2 American Society of Mechanical Engineers, Annual Meeting, Statler Hilton Hotel, New York, N. Y.

HERE'S YOUR ANSWER TO DRIVE PROBLEMS



ATLAS CHAIN
POWER DRIVE CALCULATOR

Get this new slide rule for fast, accurate selection of roller chain and sprockets on all types of drives. Covers service factor and design horsepower . . . the number of teeth required on driving sprocket . . . how to select sprocket size . . . converts length into pitches . . . to length in feet or inches. Combines six "power slide rules" into one handy calculator.

This Atlas calculator is just another step ahead in the field of more efficient power drives by Atlas Chain. There's an Atlas Chain to fit your every need—ASA roller chain, special chains, extended pitch chains, offset sidebar chain, or Flat-Veyor chain . . . plus sprockets and flexible couplings.

Atlas engineers are ready, willing and able to show you how to apply these Atlas products for peak efficiency. Atlas Power Transmission Products include every step to improve your drives and reduce your operating costs. Write today for your free calculator and full data on Atlas Power Products to . . .

ATLAS CHAIN & MANUFACTURING COMPANY
WEST PITTSTON, PA.
Subsidiary of Prudential Industries, Inc.

ATLAS

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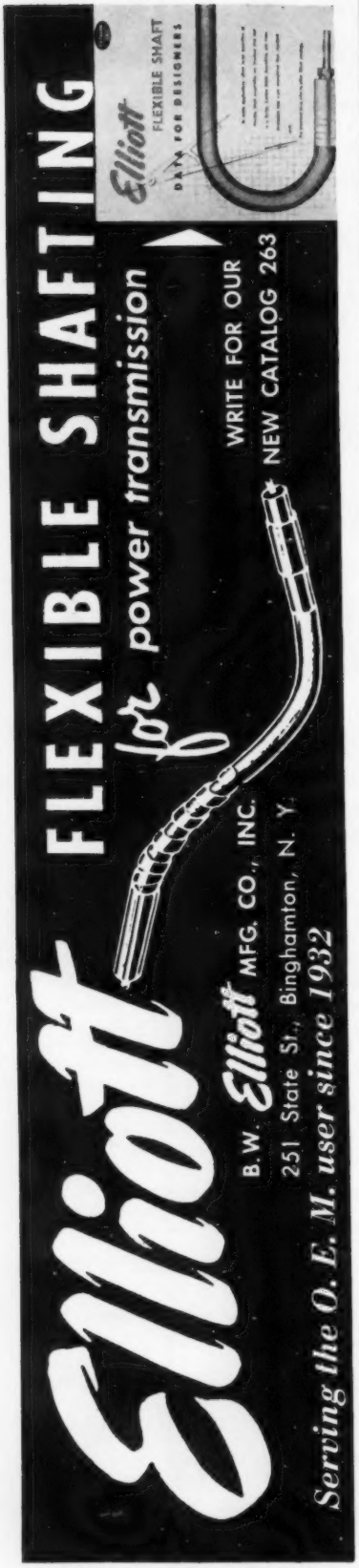


Circle No. 15 on Reader Service Card

MEN *of the power transmission field*

Timken elects president, three new directors

CANTON, OHIO—W. R. Timken has been elected president of The Timken Roller Bearing Co. He succeeds D. A. Bessmer, who resigned because of ill health. Timken joined the firm in

TIMKEN

1935, was elected a director in 1936, and became a vice president in 1941. Also elected were these directors: G. L. Deal, secretary-treasurer; F. J. Reeves, vice president, sales; Henry Tobey, vice president, manufacturing, Bearing and Rock Bit divisions.

Staff promotions at Boston Gear

QUINCY, MASS.—Boston Gear Works has promoted three members of its management staff: Edgar V. Rankin, former general manager, is now vice president; William R. Kunkel, former assistant general manager, is now general manager; Robert G. Emerson, Jr., becomes assistant general manager.

Sewall names officers

ST. PAUL, MINN.—E. B. Sewall has retired as president of E. B. Sewall Mfg. Co. The firm, now known as Sewall Gear Mfg. Co., elected these officers: president—William J. Haag, who has been with the company since it was founded; vice president and treasurer—Richard H. Ewert, formerly with Foote Bros. Gear & Machine Corp.; secretary—E. R. Sewall, who will continue as general superintendent.

New general managers at Eaton divisions

CLEVELAND, OHIO—Eaton Mfg. Co. has appointed general managers for two of its divisions: Paul W. Olson, formerly general manager of the Foundry Div., is now general manager of the Marion Forge Div.; George R. Frye, formerly factory manager of the Foundry Div., succeeds Olson as general manager of that division.

American Pulley names Pittsburgh rep.

PHILADELPHIA, PA.—Robert Bowser has been appointed district manager, Pittsburgh area, for The American Pulley Co.

Flounders joins Boston

CAMBRIDGE, MASS.—James M. Flounders has been appointed vice president, research and development, for Boston Woven Hose & Rubber Div., American Biltrite Rubber Co., Inc.

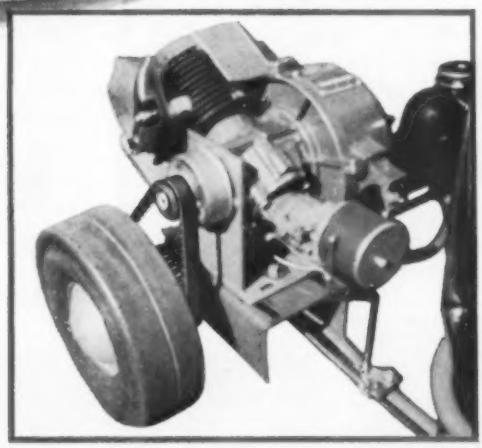
FLOUNDERS

He succeeds Norman J. Cyphers, who resigned. Flounders formerly was director of new product development for B. F. Goodrich Industrial Products Co.

Mericka is chairman of Van Norman board

NEW BEDFORD, MASS.—William J. Mericka has been elected chairman of the board of Van Norman Industries, Inc. He succeeds Donald P. Hess, who retired recently. All other

US RUBBER **PowerGrip** "TIMING" BELTS from the Power Unlimited complete belt line



Even the youngsters are making time with the U.S. PowerGrip "Timing" Belt

Howard Industries, Inc. (Sumter, S. C.) use the U. S. PowerGrip "Timing"® Belt to get perfect transmission response on the Go-Karts they manufacture.

Says Howard E. Short, president, "This car is being raced with gratifying results by children and adults. The U. S. PowerGrip 'Timing' Belt provides positive transmission of power. Our engine is a 2½ h.p., 2-cycle chain saw engine turning up at 6200 r.p.m.

"U. S. PowerGrip 'Timing' Belt drives made it possible to economically convert this motor for installation in the Go-Kart. Since 'Timing' Belts are fixed drives, they need no maintenance or adjustment and they whiz the Go-Kart along at speeds of 35 to 60 miles per hour, depending on the drive ratio."

U. S. PowerGrip "Timing" Belts with speeds ranging to 16,000 r.p.m. and up to 1000 h.p. have made possible not only the efficiency of the Go-Kart, but literally the design and production of hundreds of appliances and equipment, ranging from sensitive electronic devices, office machinery, household equipment and gigantic production machinery.

One way to get expert transmission counsel is from the U. S. Rubber Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

US RUBBER Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

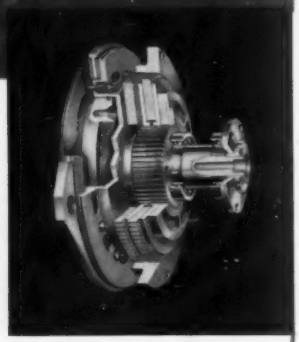
Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

Circle No. 41 on Reader Service Card

FOR OEM

- Controlled single or multiple cycling within a wide range of speed.
- Clutch and brake in a single synchronized unit.
- Adaptable to mounting on crank, cam or drive shaft for flywheel or geared applications.
- Can be used with flywheel, gear or drive-spider and mounted outboard or between bearings.
- Constant or variable clutch torque.
- Compact, space-saving, easily installed.
- Minster Electrical Controls to your requirements.

Write for OEM Clutch Bulletin CFC-54.

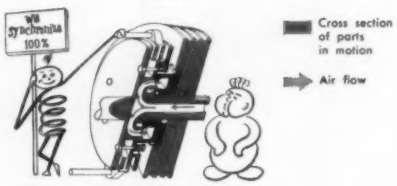


Combination Clutch and Brake

Air-Operated • Compact

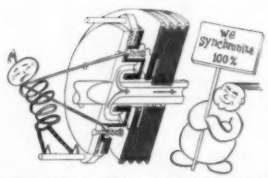
Fast Acting • Perfectly Synchronized

RUN



AIR IN—CLUTCH ENGAGED—(brake off)

STOP



AIR OUT—BRAKE APPLIED—(clutch disengaged)

FOR PRESS CONVERSION

A Minster clutch conversion is the most profitable way to increase press efficiency. It eliminates down-time . . . reduces maintenance and parts replacement . . . increases die life . . . reduces operator fatigue . . . improves safety and increases production.

Minster conversion units, made by a press manufacturer who knows your problems, are standard clutches individually applied to your press. Complete with flywheel and shaft, ready to drop in place. Thousands in daily use.

Write for Clutch Conversion Booklet CC57.

THE MINSTER MACHINE COMPANY · MINSTER, OHIO

MINSTER®

Circle No. 29 on Reader Service Card

corporate and divisional officers were reelected. Mericka, president of Wm. J. Mericka & Co., Inc., was a Van Norman director since 1956.

Twin Disc's Batten dies; was founder

RACINE, WIS.—Percy H. Batten, founder and chairman of the board of Twin Disc Clutch Co., died recently. He formed the company in 1918,

BATTEN

together with Arthur B. Modine and T. L. Fawick. Mr. Batten became president in 1922, and board chairman in 1948.

Marmor joins Garlock

PALMYRA, N. Y.—James Marmor has been appointed contract coordinator of the Military Products Dept., Marketing Div., The Garlock Packing Co. Formerly with the Missiles and Space division of Lockheed Aviation, Marmor will be responsible for military contract accounts west of Salt Lake City.

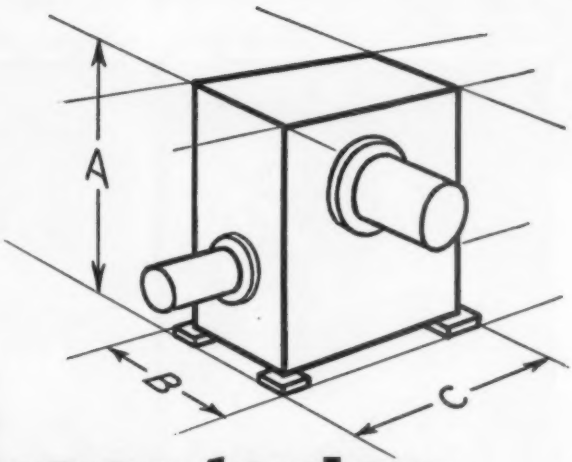
Vard names Maletz chief gear engineer

LOS ANGELES, CALIF.—Michael Maletz has joined Vard Div., Royal Industries, Inc., as chief gear engineer. He formerly was in charge of gear engineering at Kearney and Trecker.

Denison Engineering names field engineers

COLUMBUS, OHIO—Denison Engineering Div., American Brake Shoe Co., has named three field engineers: Jean A. Chabot will cover Connecticut, Maine, Massachusetts, New Hampshire, upper New York, Rhode

Do-It-Yourself...



Let's design a speed reducer today

So you can't find a speed reducer to fit your latest brainchild without ruining the design? Doggone manufacturers all build reducers too big to fit into those few cubic feet you've got left for the reduction unit back behind the double-ended dingbat?

Revolt! Design your own! Show 'em!

By George, design it yourself and it'll fit. How? Well, you know your size limits. Draw the biggest box that'll fit the space and you've got your reducer housing specifications.

Now you need gears that will (1) transmit the needed horsepower under all operating conditions, (2) provide the ratio your machine requires and (3) fit the space that's available. You'll soon discover that there are limits to what gears can do in transmitting horsepower. The cheapest answer is parallel shaft helical gears. If they'll fit you're in clover. But they take the most room, especially when you're out of the fractional hp range. The right angle worm and gear combination is the most compact drive arrangement.

Here again you have a choice. Cylindrical worm gearing is often used, and if it'll do the job, is worth consideration. But it's not the most compact possibility. The best way to shrink gears and still carry the load is the double-enveloping worm gear design. Both worm and gear are throated and the two literally wrap around each other. This brings center distance of the two shafts closer together and you can put them inside smaller housings.

Does this reduce load capacity? No sir! You can carry the same load with center distances up to 33% smaller than those of cylindrical worm gears. Or use the same center distance and carry a greater load. Will these gears hold up in operation? Sure, if you beef up the teeth, the bearings and the housing. Use straight-sided worm and gear teeth and you'll get all the strength there you'll ever need. Use large taper roller bearings with real B-10 life. Use a reinforced, heavy wall housing that won't distort under load. Put fins on it for added cooling and increased thermal horsepower capacity to meet your needs. Now, put the whole thing together and you've got a speed reducer that's a dilly.

Designing your own speed reducer give you a headache? Looking for an easier way? There is one. Someone's already done exactly what you're talking about. You can order that compact speed reducer right off the shelf. Where?

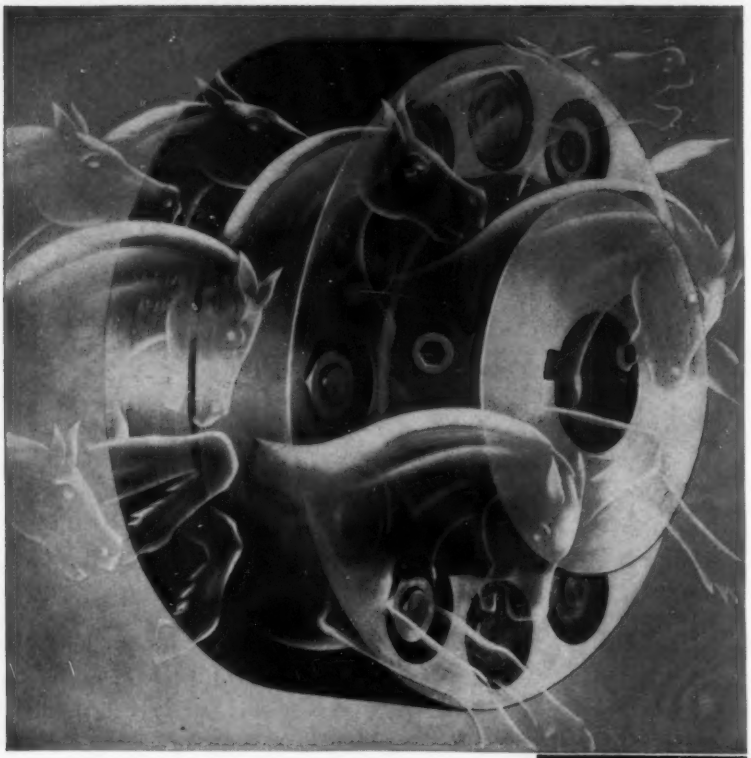
Cone-Drive Gears, that's where!

Yes sir. They stock double-enveloping worm gear speed reducers from fractional to 665 hp. Standard ratios from 5:1 to 70:1 in about 15 increments, all interchangeable in any type housing of a given center distance. Worms over and worms under. Gear shafts vertical, too. Single- or double-extended output shafts, or shaft mounted. Over 200,000 combinations possible. Wow! Just about anything you want.

Better get Cone-Drive's new speed reducer catalog that details everything. Ask for Bulletin CD-218. Cone-Drive Gears, Div. Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

Circle No. 9 on Reader Service Card

ALL THE HORSEPOWER GOES THROUGH THE COUPLING



The Basic Reason Why it Pays to Use AJAX FLEXIBLE COUPLINGS!

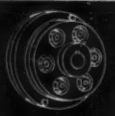
For Original Equipment and Replacement... It costs far less to safeguard bearings, gears, impellers, armatures, housings, and other working parts than today's high cost of repairs and shutdowns!

Whether you design, build, install, operate or service direct-connected machines, look into all extra economies of AJAX FLEXIBLE COUPLINGS.

Made in a complete line of types and sizes,—phone or write for catalog.

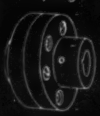
RUBBER-CUSHIONED SLEEVE BEARING TYPE

DIHEDRAL GEAR TYPE



Ajax Type SP Shear Pin Coupling

Ajax Type BO Bolt-On Coupling



Ajax Type M Mill Motor Coupling

Ajax Type BD Broke Drum Coupling

AJAX

AJAX FLEXIBLE COUPLING CO. INC.
132 Portage Road, Westfield, N. Y.
In Canada—The Alexander Fleck, Ltd., Ottawa

Send catalog covering Flexible Couplings.

Name_____
Concern_____
Address_____

Circle No. 6 on Reader Service Card

Island, and Vermont out of Manchester, Conn.; Ernest W. Cummings will cover western Pennsylvania and West Virginia out of Pittsburgh; Robert H. Hamilton will cover Delaware, Maryland, southeastern Pennsylvania, Virginia, and the District of Columbia out of Philadelphia.

Schaefer joins Wood's

CHAMBERSBURG, PA.—Milo L. Schaefer, Jr., has joined T. B. Wood's Sons Co. as district sales manager for the Newark-Hartford territory.

SCHAEFER

His territory includes northern New Jersey, the New York City industrial area, Connecticut, and Rhode Island. Schaefer had been with Gates Rubber Co. for 20 years, most recently as New York district manager.

Weiser is president of Minnesota Bearing

MINNEAPOLIS, MINN.—Robert D. Weiser has been elected president of Minnesota Bearing Co., succeeding J. K. Weiser. Formerly sales manager, Weiser joined the firm in 1946, and became a salesman in 1952.

C. T. Young dies

PASSAIC, N. J.—Charles T. Young, who had been active in the rubber industry for 62 years, died recently. He was 90. Mr. Young, who started with the New York Belting & Packing Co., joined the Manhattan Rubber Mfg. Co. in 1895. He became factory manager in 1911, secretary in 1913, a director in 1914, and vice president in 1916. In 1929, following the merger which formed Raybestos-Manhattan, Inc., he continued as factory manager until his retirement in 1946.

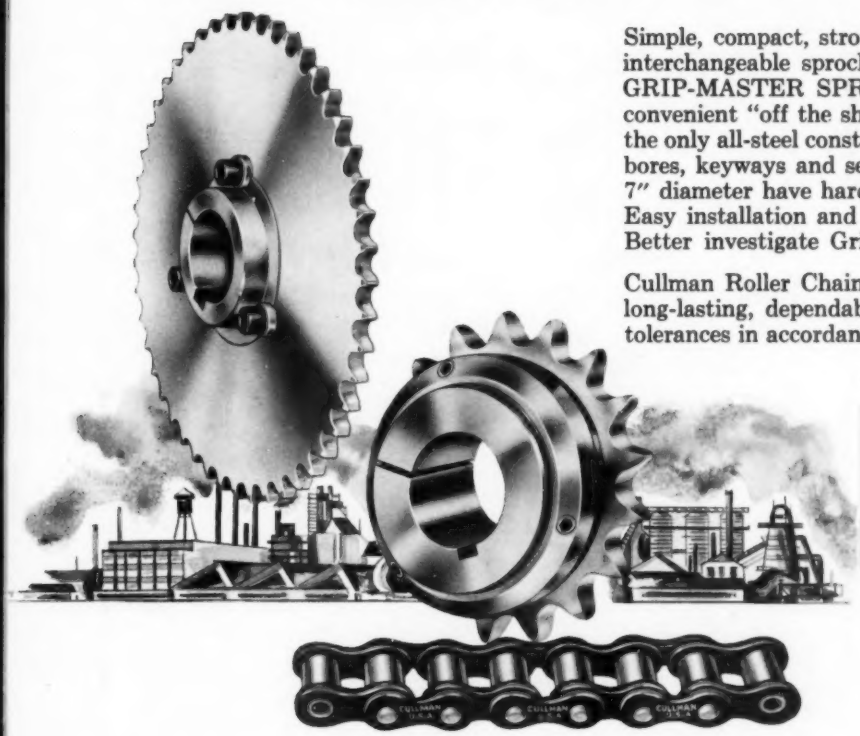
Circle No. 11 on Reader Service Card ——→

Complete line of Sprockets, Chains, Flexible Couplings . . . everything you need for quality Roller Chain Drives.

cullman

Cullman *Grip-Master*® Sprockets

sure to reduce chain drive costs!



Simple, compact, strong . . . featuring interchangeable sprockets, hubs and bushings—GRIP-MASTER SPROCKETS are ready to use in convenient "off the shelf" sizes and styles . . . the only all-steel constructed sprockets with standard bores, keyways and setscrews. Sprockets up to 7" diameter have hardened teeth for longer wear. Easy installation and removal. Better investigate Grip-Master today.

Cullman Roller Chain . . . precision-made, long-lasting, dependable—manufactured to close tolerances in accordance with A.S.A. specifications.

Distributors in all principal cities.

FACTORY WAREHOUSES AT:
821 So. Santa Fe Ave., Los Angeles 21, Cal.
239 West 18th St., New York 11, N. Y.
2618 Carnegie Ave., Cleveland 15, Ohio
205 North 11th St., Tampa 2, Fla.

Cullman Wheel Company 1344 Altgeld Street • Chicago 14, Illinois

write today for latest free literature . . . competent engineering counsel on all your chain drive problems. No obligation!

Roller Chain Drives Since 1893

wheel

IN WAGNER GEARDRIVES...

HIGH-HARDNESS GEARS

provide greater power transmission capacity... longer wear life... greater resistance to shock

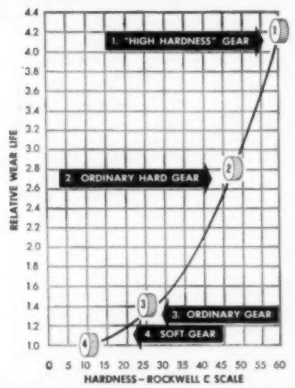
Wagner Gear Drives are built with "High Hardness" gears... made from forged blanks of alloy steel, carefully hardened *after* cutting. This special process develops file-hard tooth surfaces with tough, ductile tooth cores . . . maintains close-tolerance accuracy. High strength with high accuracy gives greater capacity, longer wear life than ordinary gears of the same size and weight, plus maximum resistance to shock. Table shows performance comparisons.

1. "High Hardness" gear... hardened *after* cutting. Precision processing permits maximum hardness while holding accuracy within extremely close tolerances.

2. Ordinary hard gear... hardened after hobbing and shaving. Hardness limited to maintain reasonable accuracy.

3. Ordinary gear . . . hardened before cutting. Hardening limited to maintain machinability.

4. Soft gear . . . excessive size required because of low capacity.

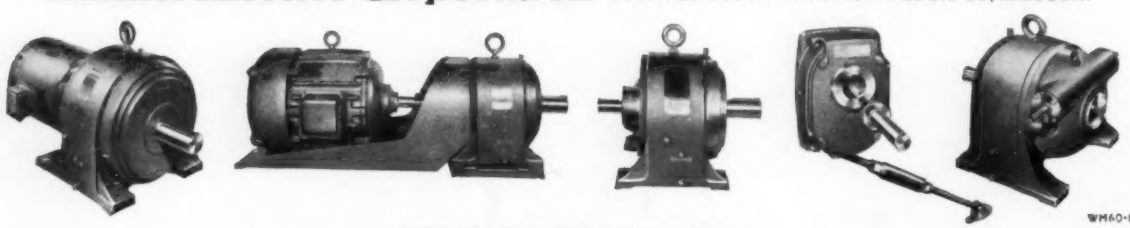


Positive, powerful, slower than motor speeds should mean one thing to you: Wagner Gearmotors. They are built to operate for years at peak efficiency. Advanced design and rugged construction with a minimum number of wearing parts, make this a certainty. Wagner Gearmotors have positive oil seals; continuous lubrication of all moving parts; extra-high capacity bearings; integral bearing housings; and rigid pyramid-mounted cast housings. Extra capacity bearings give them high overhung load ratings, too.

Wagner makes both integral-type and all-motor gearmotors, speed reducers and shaft-mounted speed reducers. They're available in single, double, triple or quadruple reductions . . . horizontal or vertical foot or flange mountings. Another important factor: prompt shipment. Standardized components permit immediate assembly of all standard sizes and types; you get equipment when you need it.

Want to know more? Call your nearby Wagner Sales Engineer; he will be glad to help you select the right drive for your application. Bulletin MU-227 gives full information.

Wagner Electric Corporation 6385 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI



WM60-15

Circle No. 42 on Reader Service Card

An introduction to . . .

Friction clutches and brakes

- **Construction**
- **Types**
- **Ratings**
- **Selection**

CLUTCHES are devices for connecting and disconnecting two shafts or rotating elements. One of the connected elements is driven by some power source. The other member is driven by the first, and relative speeds of the connected members may vary from fully engaged to completely disengaged.

Brakes are used to connect rotating elements to stationary elements to slow or completely stop rotation. As far as actual construction of clutches and brakes is concerned, they may be identical, because a brake may be defined as a clutch where one of the connected members is anchored, or stands still.

All clutches and brakes fall into three large groups. The distinction is made on the basis of the power transmission means. The three groups are:

1. Mechanical
2. Hydraulic
3. Electrical

In the mechanical group, clutching or braking is performed by engaging or disengaging mechanical parts. A fluid in motion transmits power in the hydraulic group. An electrical field transmits power in the electrical group and there is no physical contact between driving and driven members.

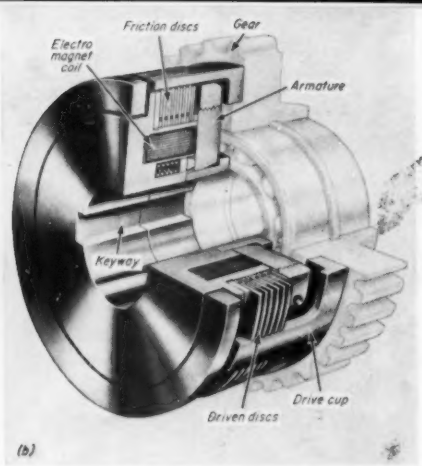
Brakes and clutches in the mechanical group may be further broken down into:

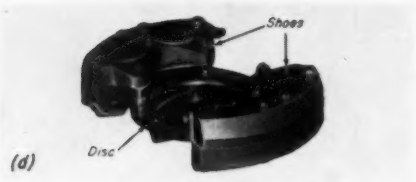
1. Friction types
2. Positive-contact types
3. Overrunning types

Friction clutches and brakes depend on the frictional force between surfaces in contact for engagement. Positive-contact types transmit torque when driving and driven members are shifted so these members interfere or mesh in such a way that there is positive physical interference. One must move when the other moves. Overrunning clutches will transmit torque in one direction only, and might be thought of as a special type of positive-contact device whose construction forces positive engagement when rotation is in the right direction.

This article will cover friction clutches and brakes. Overrunning and positive-contact types will be the subject of an article to appear next month.

There are many variations in design and construc-





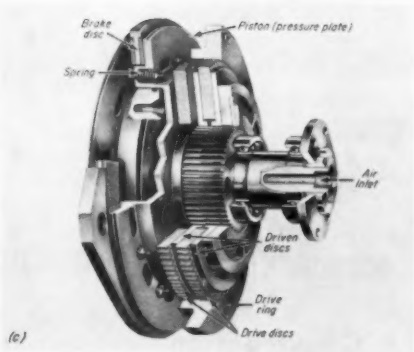


Fig. 1—Typical disc clutches and brakes. Mechanically-operated, single-disc clutch, *a*, is for automotive use. Pressure plate assembly fastens to engine flywheel with machine screws. Driven disc drives transmission input shaft when clamped between pressure plate, and flywheel. Multiple-disc, electromagnetic clutch, *b*, engages when current through coil attracts armature to clamp friction discs together. Clutches and brakes with similar friction disc setup are available for mechanical, or oil actuation. By anchoring the drive cup, this clutch could be used as a brake.

Air-operated, dual-disc clutch-brake, *c*, engages clutch and disengages brake when air supplied through the inlet moves the piston to the right. Spring gives positive disengagement when air pressure is released and applies brake. Aircraft disc brake, *d*, clamps a disc which revolves with wheel as hydraulic pressure is applied.

tion of friction clutches and brakes. For example, the means to force the contacting surfaces against each other may be muscle, air pressure, hydraulic pressure, centrifugal force, springs, or electromagnetism. Disengagement may be done by any of these.

Construction separates friction clutches into disc and drum types. In the disc type, one or more discs are moved axially to make contact with the mating surfaces. Motion toward or away from the center of rotation in a radial direction is used in drum types. Figure 1 shows some typical disc clutches and brakes. Some drum types are shown in Figure 2.

Unlike the positive engagement types, friction clutches and brakes permit partial engagement, or slip. This makes it possible to get smooth acceleration or deceleration of a load. And, since the torque capacity is proportional to the force holding the friction surfaces in contact, friction clutches are sometimes used as variable-slip speed controls. Since the slippage results in heat, this may be done only on a very short time duration basis or forced cooling must be provided.

Air Operated

Air-operated clutches can be either disc or drum type, see Figures 1 and 2. The drum types may be either internal-expanding or external contracting. In the first of these, air under pressure forces friction shoes out against the inner surface of a drum to engage; shoes are forced inward against the outer surface of a drum, in the other. The rubber tube which is expanded to cause engagement in these clutches serves as the disengaging spring.

Integral pistons are used to engage some air clutches. Here, springs are used to disengage. A combination clutch-brake unit, used primarily on press drives, has a spring-applied, air-released brake, Fig. 2c.

All air-operated clutches offer the possibility of remote control either by hand-operated, solenoid-controlled, or other types of air valves. By appropriate valving, the time-torque cycle of an air clutch can be made to fit almost any condition, Figure 3.

Many air-operated clutches and brakes require no adjustment for wear. Another interesting feature of the air-operated clutch is that it may be used to give overload protection by regulating air pressure

applied to a value such that the clutch will slip at whatever percentage of overload is selected.

Ratings: Air-operated units are available in a wide range of torques and horsepowers. Torque ratings range from roughly 1000 to 30,000,000 in.-lb. Horsepowers range from approximately 2 to 2000.

Air pressures for clutch and brake operation are usually specified from 50 to 100 psi. Air at these pressures is normally available in industrial plants. Where the unit is operated by a metallic piston, the air must be well filtered and lubricated.

Styles and mountings: Clutch and clutch-brake units may be mounted on the machine with which they are used, or they can be gotten on foot mountings for coupling to driving and driven shafts just as a speed reducer or electric motor might be.

All units are available for outboard, or overhung, mounting on the face of a flywheel or gear. They may also be installed between bearings, or on split shafts where the driving shaft comes in one side and the driven shaft the other, Figure 2b.

In most cases, air clutches and brakes are complete, ready-to-use units. However, many manufacturers will provide the friction disc or drum subassembly with the operating parts for integration into a machine. Here, the mating drum or metallic disc must be pro-

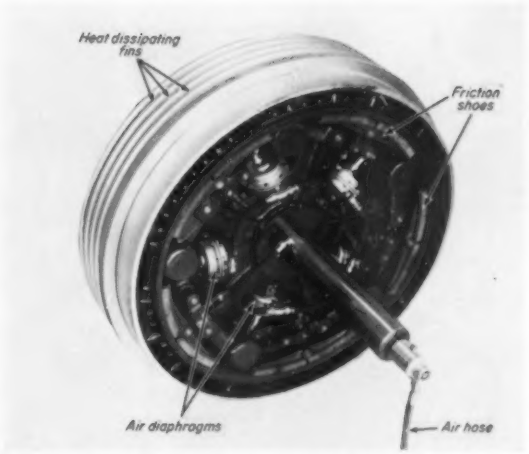
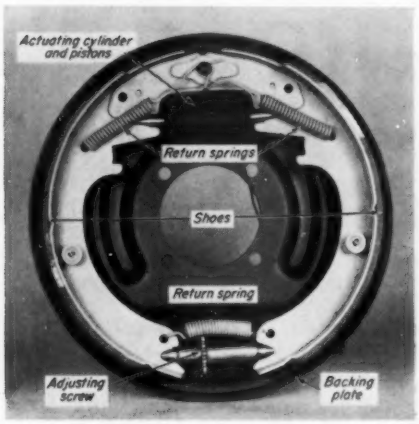
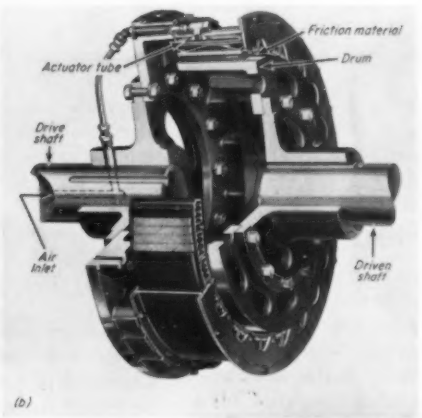
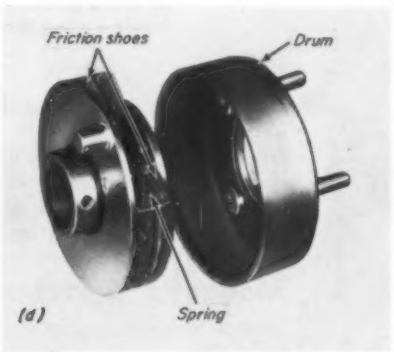


Fig. 3—Air control of transmitted torque and design for heat dissipation make this clutch suitable for tension control applications. Torque must vary to maintain constant tension as diameter changes when winding up sheet or strip material. Construction differs from other types described. Multiple shoes are actuated by individual air diaphragms.







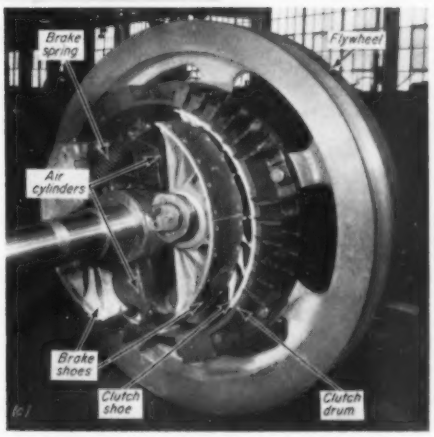


Fig. 2—Typical drum clutches and brakes. Automotive brake, *a*, is mounted to axle by four holes shown in the backing plate. Drum (not shown) attaches to wheel. Hydraulic pressure in actuating cylinder forces shoes out against drum. This is internal-expanding construction. Air-operated clutch, *b*, drives drum and shaft when actuator tube is inflated. Note the many openings for passage of air through the clutch members for cooling. This is an external-contracting unit.

Large air-operated clutch-brake, *c*, is 36-in. diam unit for a press. Springs are used to disengage clutch and engage brake when actating force is removed. Brake drum (not shown) fastens to machine frame. Centrifugal drum brake, *d*, operates when centrifugal force on shoes exceeds spring force and shoes are thrown out against the inner surface of the drum.

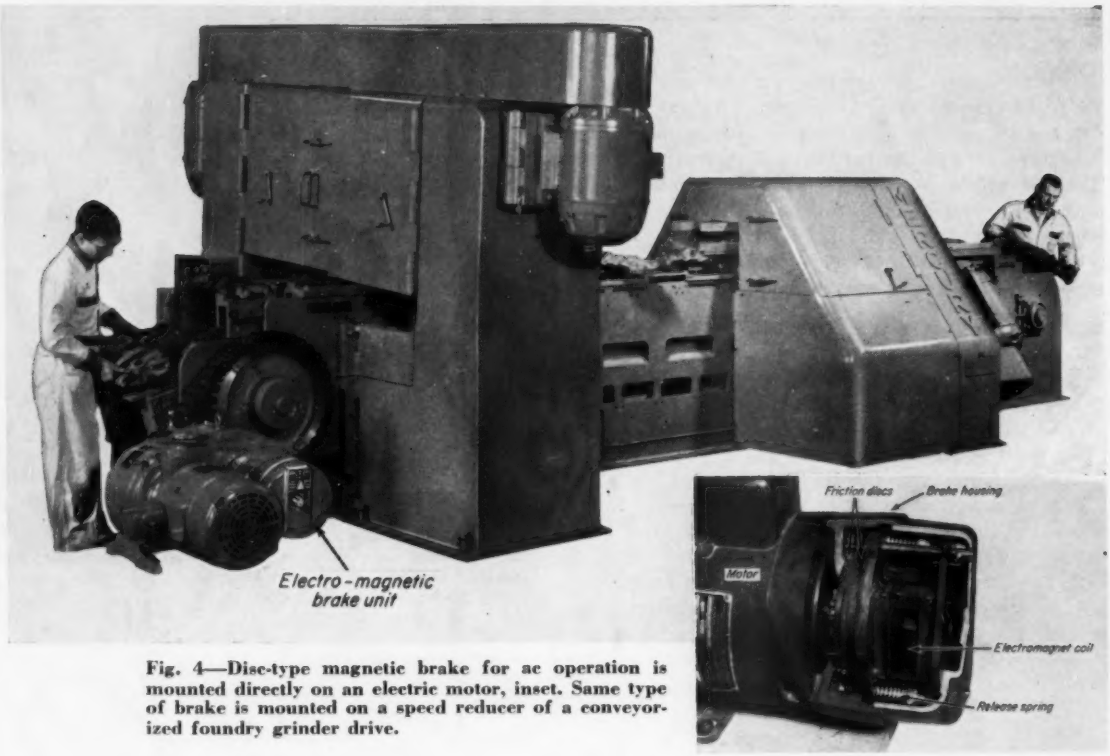


Fig. 4—Disc-type magnetic brake for ac operation is mounted directly on an electric motor, inset. Same type of brake is mounted on a speed reducer of a conveyorized foundry grinder drive.

vided by the user. Close co-operation with the manufacturer is necessary in these cases. Of course, the manufacturer's recommendations for material and surface finish of mating parts must be followed.

Magnetic Clutches and Brakes

In most magnetic brakes and clutches, conventional friction discs are forced into mechanical contact by electromagnetic force. They may be either single or multiple disc types. The electromagnet is dc-operated at 6, 12, 24-28, 90, 115, 230, or 460 v in the majority of units. However, there is one brake designed for operation on standard ac voltages, Figure 4.

Fast action, remote control, no need for adjustment and torque control, Figure 5, are features of these units. Many of the minature brakes and clutches used in servo applications are of this type.

There's another type of magnetic clutch where there is no axial movement of friction discs. A gap between driving and driven members is filled with magnetic particles. When the coil is not energized, the loose particles have no friction effect. Energizing the coil causes the particles to cling to each other and bridge the gap between driving and driven members. Friction and magnetic forces are sufficient to let these units operate at zero slip. Slippage which occurs during engagement and disengagement is between the magnetic particles, so there is little or no wear on driving and driven members.

Magnetic particle units are available in sizes from a few oz-in. to 200 lb-ft. Because of their construction, they are usually supplied as housed units with stub shafts for foot or servo mounting, Figure 6. A brake unit is available for flange mounting.

For use where dc is not available, manufacturers of dc-operated clutches usually have rectifier equipment available for use with their clutches. Actual electrical power consumption is very small. For example, 35 watts is all that's needed to operate a 50-hp clutch.

Styles and mountings: Units are available as clutches and brakes alone, or in clutch-brake combinations. Clutch-couplings for mounting between two shafts to be joined are also available from some manufacturers. In a few cases, units may be complete in a housing for base mounting, Figure 7.

Many miniature clutch and clutch-brake units are quite different in appearance from other types. Most of them resemble small electric motors, Figure 8, and are intended for servo mounting. That is, they must be face mounted or somehow clamped around the body of the unit.

The majority of standard-size units are made for mounting on your shaft, flywheel, etc. Miniature units have their own shafts and must be connected to driving or driven shafts by couplings. Of course, gears, pulleys, or sheaves may be mounted on the shafts of the miniature units. Standard shaft sizes for U. S. made miniature units are $\frac{1}{8}$ and $\frac{1}{4}$ in. diam.

Ratings: Maximum torque ratings of clutches and

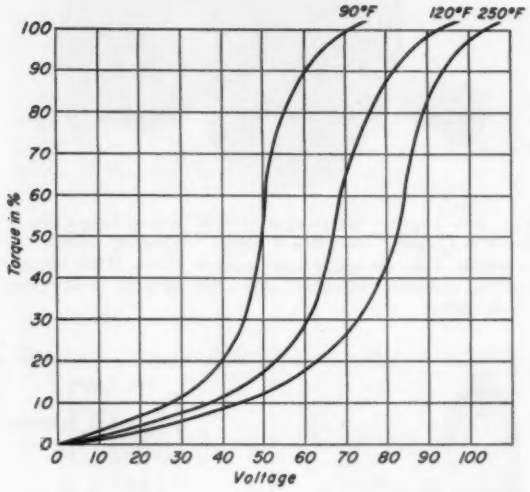
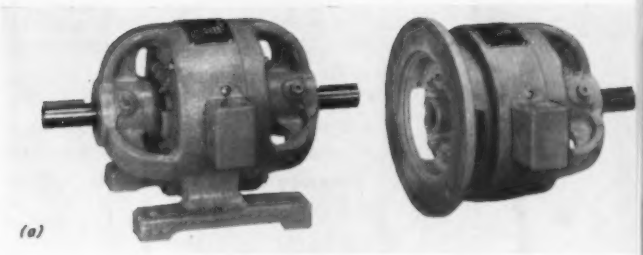


Fig. 5—Excitation Voltage vs. Torque for an electromagnetic clutch. Graph shows how torque may be adjusted. Differences shown for different temperatures point out that current rather than voltage control should be used to compensate for temperature instability of the electromagnets if precise control and setting repeatability are needed.



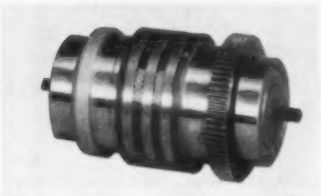


Fig. 6—Magnetic particle clutches and brakes. Because of construction, these are completely housed. Miniature unit has maximum rating of 1.5 in.-lb, contains two clutch units and is designed to provide reversal by connecting both clutch outputs to a common output shaft with an idler on one side.

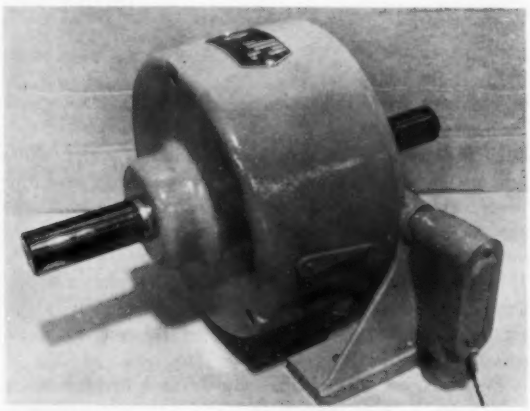


Fig. 7—This ac-operated brake is complete in its own housing. This construction is not typical of the general run of clutch and brake units.

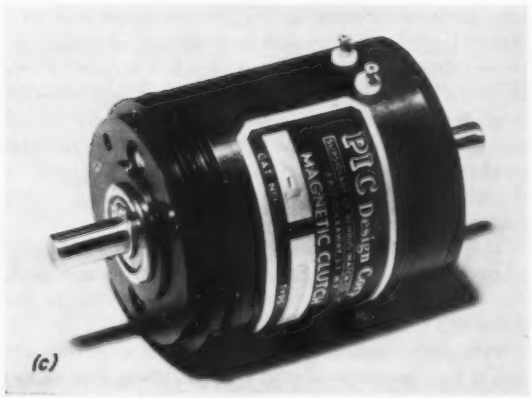


Fig. 8—Some typical miniature electromagnetic brakes and clutches. These are available as clutches, brakes, and clutch-brakes. Some have concentric input and output shafts.

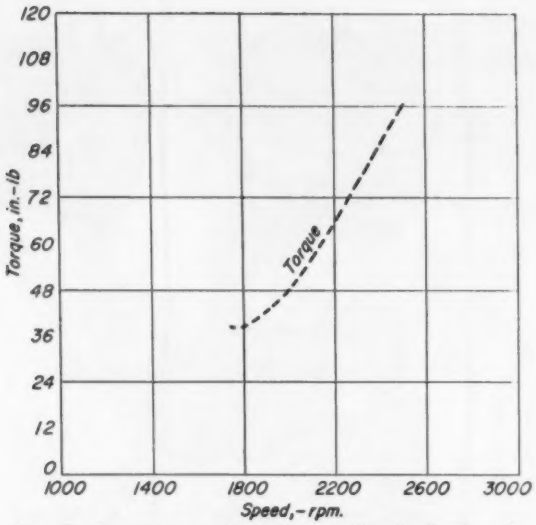


Fig. 9—Torque capacity of centrifugal clutches increases as speed increases. Engaging speed can be controlled by springs to give almost any value wanted.

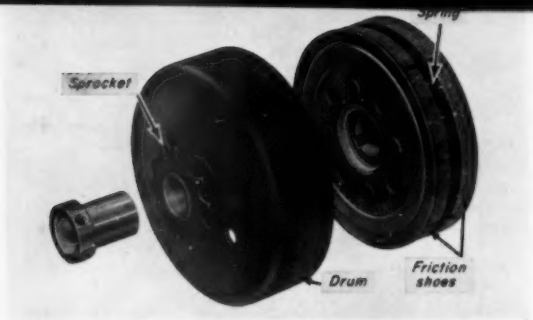


Fig. 10—Typical centrifugal clutch. Spring keeps shoes from engaging the drum until engaging speed is reached. This spring wraps around shoes. This clutch has a sprocket integral with the driven drum for chain drive.

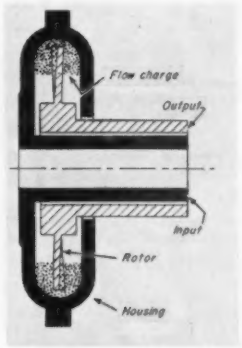


Fig. 12—Friction between housing, rotor, and charge of heat-treated steel shot connects driving to driven member in this centrifugal clutch. Centrifugal force and the amount of shot determine torque capacity.

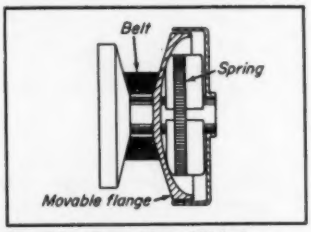


Fig. 11—Centrifugal V-belt clutch has conical weights which force movable flange inward as they move away from the center of rotation.

brakes in this group range from about 2 oz-in. to 12,000 lb-ft. Maximum permissible operating speeds are as high as 8000 rpm for the small units. Speeds are lower as the size of the unit increases.

Centrifugal Types

Outstanding feature of centrifugal clutches and brakes is that their torque transmitting capacity varies greatly with the speed at which they are driven, Fig. 9. This feature dictates the sort of applications where they are used. Because of this, they are often used with internal combustion engines and electric motors to let these prime movers start up and reach a speed where they can carry the load, before the load is connected. And, this happens automatically. No external speed or load sensing equipment is needed. With the internal combustion engine this simplifies control; only a throttle is needed to control both speed and clutch engagement.

This feature also makes centrifugal clutches useful when standby or alternate power sources are used. The centrifugal clutch automatically disconnects the one that's not running.

The centrifugal feature also makes these devices useful for automatic overspeed protection. Just as the centrifugal clutch will not engage below a certain speed, the centrifugal brake will not. Thus, with what is normally the driven member anchored, a centrifugal unit will automatically start braking when set speed is reached and brake torque will increase as speed increases.

In the majority of centrifugal clutches and brakes, friction shoes are driven, and forced out against the inner surface of a drum by centrifugal force. Springs are used to restrain outward movement of the shoes until a particular engaging speed is reached, Figure 10. This is usually the case with overspeed brakes and internal combustion engine applications where it is desirable to have no load at all on the engine until speed above idle is reached.

There is one centrifugal clutch designed to work only with V-belts that differs in operating principle from the rest. In this clutch, Figure 11, centrifugal weights bear against one side of a movable V-belt sheave flange. As centrifugal force moves the weights away from the center of rotation, they force the movable flange toward the fixed flange to engage the belt. Mating surfaces of the weights and flange are conical. These units may also be used as centrifugally-variable-pitch sheaves by incorporating some method for letting center distance change.

Another interesting departure from usual design is a centrifugal backstop brake. This unit uses pivoted shoes which are self energizing for one direction of rotation. Thus, any movement in that direction causes the shoes to engage the drum. Startup in the opposite direction forces the shoes away from the drum and centrifugal weights hold the shoes clear of the drum as speed increases. So, there is no drag at all at operating speeds.

Another variation in centrifugal clutch design is

called a dry fluid drive by its manufacturer. In this unit, Figure 12, a quantity of steel shot in a housing engages the driven member—a disc with bent-in undulations—when centrifugal force throws shot to the outside of the housing. Engagement is by friction between rotor, shot, and housing. Units of this type are available for transmitting up to 1000 hp.

Styles and mountings: Centrifugal clutches are available with integral sheaves and sprockets, and for toothed belt drives. They are also available as clutch couplings and with crowned or flat pulleys for flat belt drives.

Ratings: Centrifugal clutches are available for a range of about 1 hp to 3000 hp. Operating speeds go as high as 10,000 rpm for the small sizes. Engagement speeds of standard models are commonly within a range of 500 to 1800 rpm. This speed range covers nearly all applications. However, these values may be easily changed for special applications by using special springs at very little additional cost.

Slip Clutches

Almost all of the clutches so far considered are, in a sense, slip clutches. If properly selected for the job, their torque capacity is within 50 to 100% of the maximum expected torque and they will slip to

Table I--Directory of Friction Clutch & Brake Manufacturers

Manufacturer	Types Manufactured
Actuator Products Corp.	3, 7
Autotronics Inc.	3
Bendix Products Div., Bendix Corp.	10
Borg & Beck Div., Borg-Warner Corp.	8
Brown Engineering Co.	7
Buffalo Machinery Co. Inc.	6
Carlyle Johnson Machine Co.	2, 7
Centric Clutch Co.	5, 6
Cleveland Aircraft Products Co.	10
Cleveland Punch & Shear Works Co.	1
Conway Clutch Co.	1, 5, 6, 7
Crofts U.S.A. Inc.	1, 2, 3, 7
Cycledynamics Inc.	2
Dana Corp.	8
Dings Brakes Inc.	2
Dodge Mfg. Corp.	1, 5, 7
Dynamatic Div., Eaton Mfg. Co.	2
Dynamic Gear Co., Inc.	6
Dynamic Instrument Corp.	3
Eclipse Machine Div., Bendix Corp.	2
Edgemont Machine Co.	6, 7
Fae Instrument Corp.	3
Fawick Airflex Div., Fawick Corp.	1, 2
Federal Seal & Gear Corp.	5
Flaton Machine Works, Inc.	6
Formsprag Co.	5
General Electro Mechanical Corp.	3
Globe Industries Inc.	3
The Hilliard Corp.	5, 6
Horton Mfg. Co. Inc.	1
Howell Electric Motors Co.	2
Industrial Clutch Corp.	1, 7, 9
I-T-E Circuit Breaker Co.	2, 3
Kearfott Div., General Precision Inc.	3
Lear Inc., Instrument Div.	4
Link-Belt Co.	7
Lipe-Rollway Corp.	8
Long Mfg. Div., Borg-Warner Corp.	8
Magtrol Inc.	3
McMahon & Co. Inc.	7
Mercury Clutch Div., Automatic Steel Products Inc.	5
Minster Machine Co.	1
Moore-Master Mfg. Co.	7
Morse Chain Co.	5, 6, 7
Orbit Instrument Corp.	3
PIC Design Corp.	3
Raymond Engineering Lab Inc.	4
Reuland Electric Co.	2
Rockford Clutch Div., Borg-Warner Corp.	7, 8, 9
Rockwell Standard Corp., Brake Div.	10
Salsbury Corp.	5
Simplatrol Products Corp.	2, 3
Stearns Electric Corp.	2, 3
Sterling Precision Corp.	3
Twin Disc Clutch Co.	1, 7, 8, 9
V-Belt Clutch Co.	7
V-Plex Clutch Corp.	5
Vickers Inc., Electric Products Div.	4
Vickery Div., Norwalk Tool and Die Inc.	6
Warner Electric Brake & Clutch Co.	2, 3
Web Controls Corp.	2
Weiland Clutch Co.	1
Wichita Clutch Co. Inc.	1

KEY

1. Air-operated clutches, brakes, and clutch-brakes.
2. Electromagnetic clutches, brakes, and clutch-brakes.
3. Miniature electromagnetic units.
4. Magnetic particle clutches and brakes.
5. Centrifugal clutches and brakes.
6. Slip, or torque-limiting, clutches.
7. General-use, mechanically-operated clutches, brakes and clutch brakes.
8. Automotive clutches.
9. Power-takeoff clutches.
10. Automotive brakes.

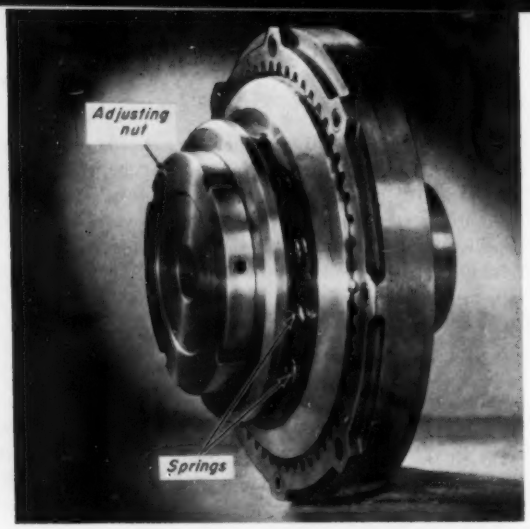


Fig. 13—Slip or torque limiting clutch shown here has a nut for adjusting spring compression and, therefore, force exerted to hold friction discs in contact.

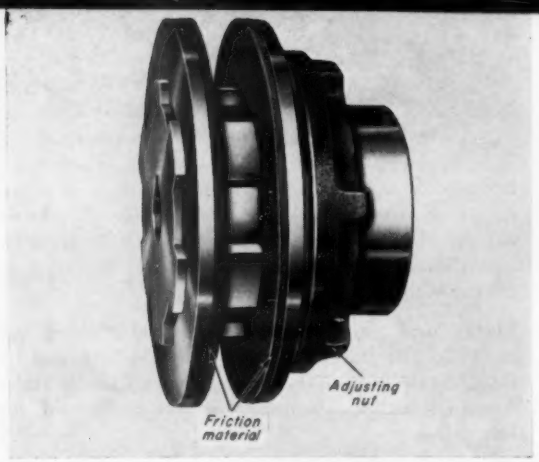


Fig. 14—This slip clutch is designed to clamp a sprocket or other power transmitting member between two discs faced with friction material. Adjusting nut increases or decreases compression of a Belleville spring. Design prevents actual clamping of the friction discs. Engaging force is always a function of spring load.

give protection to both driving and driven components when this value is exceeded.

There are, however, clutches designed solely for protection against overloads rather than controlled engagement and disengagement of driving and driven members. These will be considered here.

Two types of slip clutches are available. One of these simply slips whenever its torque capacity is exceeded and picks up the load again when conditions are normal, Figure 13. This type of clutch continues to transmit the set torque during the time it slips. These are sometimes used for tension control on wind-up drives and the like. The other type of slip, or overload, clutch disengages when its rating is exceeded so the driven member stops.

Certain slip clutches are made for engage-disengage service in addition to their other features. Some, intended for continuous-slip service, may be adjusted while running.

Styles and Mountings: Slip clutches are made for overhung mounting and as clutch couplings. Some are made to be used with a sprocket or other member as one of the clutch members. The sprocket is then sandwiched between the friction facings of the clutch, Figure 14. The majority of slip clutches come with a hub on which you may mount a sprocket, sheave, gear, or any other similar power transmitting member.

Ratings: Torque ratings for slip clutches are from a few in.-lb to nearly 25,000 ft-lb. Operating speeds are consistent with those of other power transmission system components.

Friction horsepower: In selecting a clutch for an application where continuous slip or fairly long periods of slipping are involved, the important factor in slip clutch selection is the friction hp. Friction hp is the difference between hp input and hp output and is converted into heat at the clutch facings. This heat must be dissipated by the clutch to maintain temperature of friction surfaces and other clutch parts at a low enough value to prevent damage from overheating.

Manufacturers of clutches intended for this type of service publish complete information on continuous friction hp dissipation ratings of their clutches as well as factors for modifying the values for conditions other than continuous slip.

Mechanically-Operated Units

With few exceptions, all the types of clutches and brakes discussed are related to or descended from mechanical types to be discussed here. The others differ primarily in the means used to actuate them.

The four basic types of mechanical friction clutches and brakes are: single-disc, multiple disc, internal-expanding drum, and external-contracting drum. Representative examples of these four types are shown in Figures 1 and 2.

There is a unit designed specially for use with V-belt drives to about 10 hp, Figure 15. It consists of a split sheave with a fixed flange and a movable flange. Engagement and disengagement are effected by sliding the movable flange toward or away from the fixed flange. These units are made for up to four belts.

One manufacturer makes a clutch which combines internal expansion and external contraction. This is called a rim-type clutch because the member which contacts the two sets of friction shoes is, of necessity, just a thin rim, Figure 16.

Best-known and probably most-widely used of the four basic types are the single-disc and internal expanding. Most automotive clutches are single-disc types. Automotive brakes are, with extremely few excepions, internal-expanding drum types.

Multiple-disc clutches or brakes are next in popularity. Compared to single-disc clutches, these units offer higher torque capacities per unit of diameter. On the other hand, single-disc units have better heat dissipating qualities.

Operation: In disc units, the mating friction surfaces are forced against each other in an axial direction.

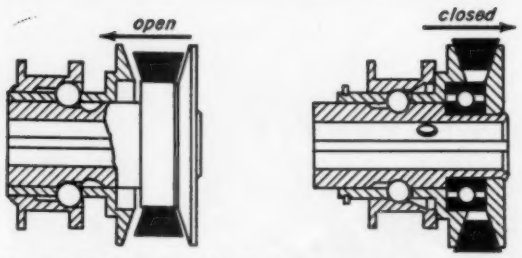


Fig. 15—Mechanical V-belt clutch is engaged by moving one flange of a sheave toward the other to grasp the belt firmly between the two flanges.

This may be done by springs, or by a mechanical linkage, Figure 17. Springs provide closely controlled pressure despite changes in thickness of the friction surfaces due to wear. Mechanical systems depend upon close control of the movement of the parts to get controlled compression of the friction surfaces. Here, periodic adjustment is necessary to maintain constant torque values.

When springs are used to engage a clutch or brake, disengagement is usually by positive mechanical means. Clutches and brakes may be had to automatically engage or disengage unless actuating force is applied. Selection of the type of release-disengage system is determined by the application. Clutches and brakes are also available to maintain engaged and disengaged positions until shifted to the other position.

Drum units are affected by centrifugal force. In internal expanding units, centrifugal force tends to increase the force with which the friction members are held together. In external contracting units, centrifugal force will decrease contact force. For this reason, drum units are in the minority in clutch applications. Also, their use at speeds above 2000 rpm is rarely recommended to minimize centrifugal force effects. Of course, centrifugal units which use centrifugal force for actuation are an exception.

Styles and mountings: Mechanical clutches are available for mounting directly on engine flywheels or for shaft mounting. Shaft-mounted types may be overhung, clutch-coupling, or through-shaft style. Double units where one or the other of two clutches may be engaged or disengaged by the same mechanism are another variation. Power takeoff units for mounting on an engine, complete in a bell housing with a stub shaft on which sheave, pulley, gear, or other power transmitting member may be mounted, are another option. Power-take-off clutch units may be had with integral gear reducers, also.

Automotive clutches are usually provided as a friction disc and pressure plate. All shafts and external release mechanism must be provided by the user. General purpose industrial clutches are complete units with shifter collar. Of course, they mount on the user's shaft or shafts.

Multiple-disc clutches of the so-called machine tool type are complete with shift collar for mounting on your shaft. However, driven members, or cups, to engage the outer driving lugs or teeth on the driven discs may be machined in a gear or other member by the user. So, these are not provided as a standard item

Fig. 16—Rim clutch has both internal-expanding and external-contracting friction shoes.

with the clutch. Certain standard types of cups may be available from the clutch manufacturer. These clutches are available for use dry or in oil.

General-purpose industrial clutches are often available with sprockets, gears, pulleys, or sheaves. They are also available with adapters for easy mounting of such components.

Ratings: Units are available for a range of torques from a few in-lb to nearly 6000 ft-lb. Maximum operating speeds are consistent with the usual range of power transmission system operating speeds.

Selection and Application

In addition to the usual requirements of fitting in the available space, being able to operate at the required speed, cost, etc., which are all fairly self evident, there are two important points to be made on the selection and application of clutches. First, if there

Table II—Clutch Service Factors

Load Type	Service factor
Steady load, smooth power source	1.2
Steady load, rough power source	1.6
Moderate shock load, smooth power source	1.6
Moderate shock load, rough power source	2.0
Heavy shock load, smooth power source	2.0
Heavy shock load, rough power source	2.4

Typical steady loads: Centrifugal blowers and pumps, conveyors (uniformly fed), generators, liquid agitators.

Typical moderate shock loads: Centrifugal compressors, ball mills, conveyors (nonuniformly-fed), feeders, grinders.

Typical heavy shock loads: Crushers, hammermills, reciprocating conveyors, feeders, 1 or 2-cyl compressors.

Smooth power sources; Electric motors, turbines, steam engines, internal combustion engines of 4 or more cyls above 700 rpm.

Rough power sources: Engines below 700 rpm or with less than 4 cylinders.

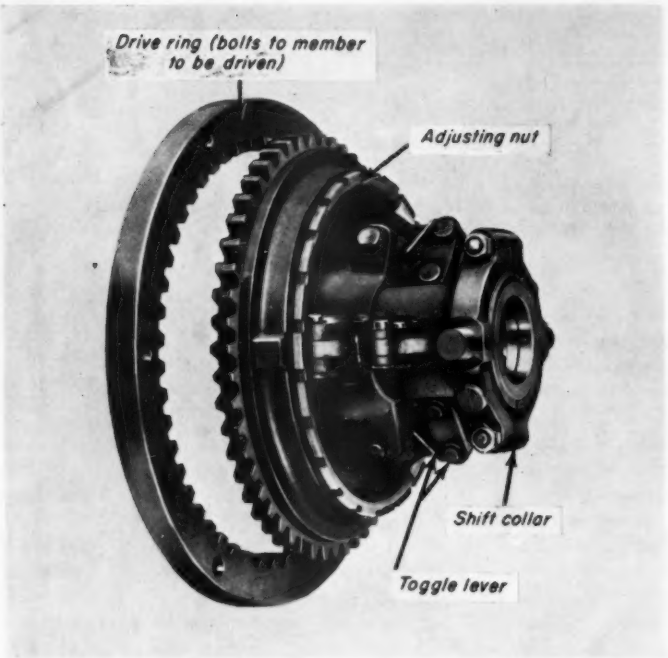


Fig. 17—Linkage-operated mechanical clutch has toggle lever linkage for engagement and disengagement. Clutch remains engaged or disengaged until shifted.

FRICTION CLUTCHES AND BRAKES *continued*

is a choice between mounting the clutch on a high-speed or low-speed shaft, it should be mounted on the high-speed shaft to reduce the torque transmitting requirement.

Second, the unit should be mounted so the heaviest part of the clutch assembly, which usually incorporates the operating mechanism, does not rotate when the clutch is disengaged. This also applies to brakes.

Torque rating: Starting point for determining the required torque rating is, of course, to determine maximum torque to be transmitted. Torque rating of the clutch should be at least double this. This value should then be multiplied by a factor which allows for the nature of the load. See Table II. The value obtained is the torque capacity required of the clutch.

Torque requirement for a clutch or brake may be determined from

$$T = \frac{Wk^2n}{308t}$$

where T = torque, lb-ft
W = weight, lb
k = radius of gyration, ft
n = speed, rpm
t = time for acceleration or deceleration

when a load must accelerate to or decelerate from a given speed in a certain length of time.

Frequency of engagement and disengagement also affects torque rating. No general rule can be given here because heat dissipation qualities of different manufacturers' units vary widely. Additionally, some manufacturers of clutches intended for particular types of service have worked this out so their published rating takes all service conditions into account. Automotive clutch manufacturers, for instance, rate their units in terms of engine torque rating.

Many manufacturers do not publish torque ratings for their units. Instead they rate in terms of hp at various speeds. In such cases, they will also publish instructions on matching unit to the hp and type of load. ▲▲▲

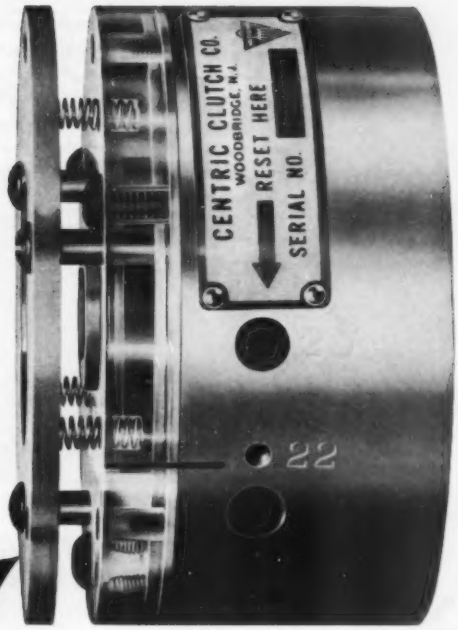
Acknowledgement

Co-operation of the following companies in providing the noted illustrations is acknowledged with thanks.

Autotronics Inc. ..... Fig. 8a
Bendix Products Div., Bendix Corp. ..... Fig. 2a
Cleveland Aircraft Products Co. ..... Fig. 1d
Cleveland Punch & Shear Works Co. ..... Fig. 2c
Conway Clutch Co. ..... Fig. 9
Crofts U.S.A. Inc. ..... Fig. 16
Dings Brakes Inc. ..... Fig. 4
Dodge Mfg. Corp. ..... Fig. 12
Dynamic Instrument Corp. ..... Fig. 8b
Eclipse Machine Div., Bendix Corp. ..... Fig. 1b
Fawick Airflex Div., Fawick Corp. ..... Fig. 2b
Hilliard Corp. ..... Fig. 13
Horton Mfg. Co. Inc. ..... Fig. 3
I-T-E Circuit Breaker Co. ..... Fig. 5
Lear Inc. ..... Fig. 6b
Mercury Clutch Div., Automatic Steel Products Inc. ..... Figs. 2d, 10
Minster Machine Co. ..... Fig. 1c
Morse Chain Co., A Borg-Warner Industry .... Fig. 14
PIC Design Corp. ..... Fig. 8c
Reuland Electric Co. ..... Fig. 7
Rockford Clutch Div., Borg-Warner Corp. . Figs. 1a, 17
V-Belt Clutch Co. ..... Fig. 15
V-Plex Clutch Corp. ..... Fig. 11
Vickers Inc., Electric Products Div. ..... Fig. 6a

FOR AUTOMATION

CENTRIC'S "TRIG-O-MATIC" OVERLOAD RELEASE CLUTCHES



Offer

A new field tested signaling actuator to be used in conjunction with the proved "Trig-O-Matic" Overload Release Clutch.

Modern high speed machinery requires torque-limiting devices that automatically disengage at a predetermined torque *to give complete overload protection.*

Centric's "Trig-O-Matic" Overload Release Clutches' unique design provides positive torque limitation without wear on the clutch. Their trigger action disconnects the load the instant an overload occurs. Along with the new signal actuator, "Trig-O-Matics" will perform these four important functions —

1. *Automatically disconnect load.*
2. *Instantaneously shut down power-drive.*
3. *Signal the occurrence of machine overload.*
4. *Maintain indexing (due to inherent design)*

When overloaded condition is corrected, the clutch is reset and operation is resumed in a matter of minutes — without special tools. The driven machine then resumes operation at the exact cycle point at which it was released.

"Trig-O-Matics" are fool proof — service-free. Do not require lubrication or adjustment. Are not affected by climate changes.

Are delivered as complete units — ready to install. Available with flexible couplings (shaft-to-shaft), sprockets, pulleys, sheaves and gears.

Standard design "Trig-O-Matics" have capacity ranges from 9" lbs. to 30,000" lbs.

Bulletin #304 completely describes "Trig-O-Matics"

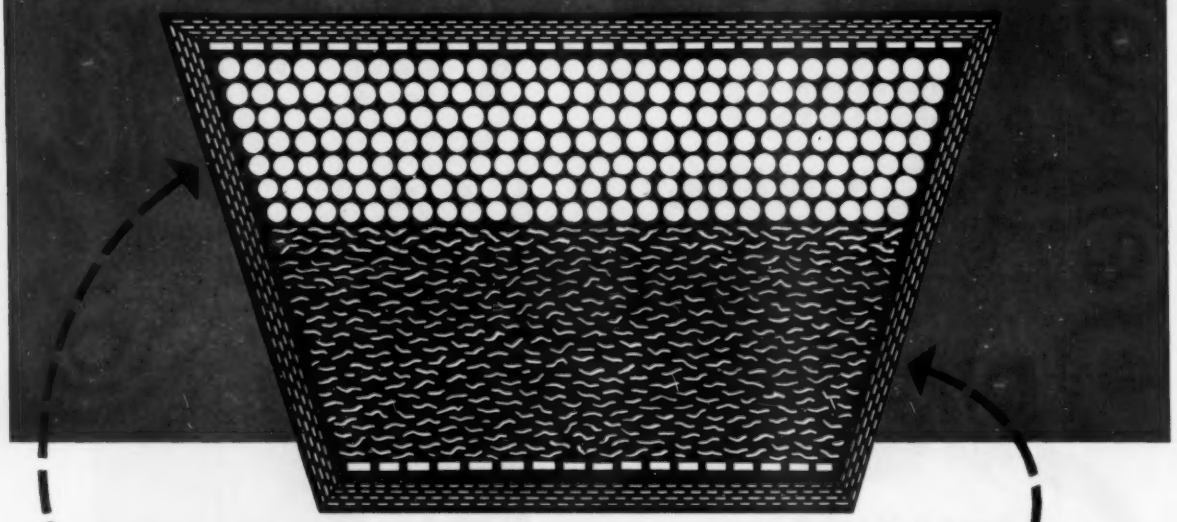
CENTRIC *Clutch Company*

Also manufacturers of the well known Centric Centrifugal Clutch-Couplings.

P.O. BOX 175 U.S. ROUTE 9 AT MAIN STREET WOODBRIDGE, N. J.

Circle No. 44 on Reader Service Card

Only BOSTRON V-Belts



are made with...

BOSTRON Tensile Members PLUS NEOPRENE with FIBER-DISPERSED Stock

GREATER STABILITY — Changes in humidity — and the resulting moisture regain — often mean a matching problem with ordinary V-Belts. The moisture regain of BOSTRON is low — 0.4% — or 1/20th that of the conventional reinforcing fiber. This means far less time spent in matching, and lower belt inventory too.

HIGHER STRENGTH — Stronger belts can withstand more shock loading, need less maintenance. BOSTRON is approximately 40% stronger than the conventional fiber used in V-Belts.

STRETCH RESISTANCE — V-Belts reinforced with BOSTRON have low stretch. BOSTRON is inherently stretch-resistant and the cords are put through a special heat and tensioning process to further minimize stretch. Thus, belts reinforced with BOSTRON show comparatively little growth — even after many months of continued operation.

GREATER RESISTANCE to oils, heat, abrasion, chemicals and ozone is provided by Neoprene.

HIGH CROSS-WISE RIGIDITY is provided by the closely-packed, straight-line formation of the fibers in the compression member.

EXCEPTIONAL LENGTH-WISE FLEXIBILITY is provided by the virtually frictionless positioning of fibers.

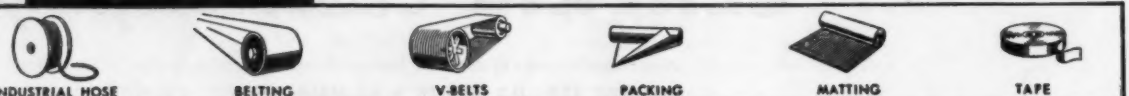
EXTRA SUPPORT for the tensile members during shock-load impact and during normal operation.

The industry's most advanced developments are now standard in the entire BOSTON Multiple V-Belt line!

● CUT DOWN MAINTENANCE ● MAINTAIN SMALLER INVENTORY ● SAVE MATCHING TIME ● SAVE TAKE-UP TIME

BOSTON

BOSTON WOVEN HOSE & RUBBER COMPANY
DIV. OF AMERICAN BILTRITE RUBBER CO., INC.
BOSTON 3, MASS.



Circle No. 7 on Reader Service Card

DESIGN
IDEAS
FROM THE FIELD

Cruciform transmission flies VTOL craft

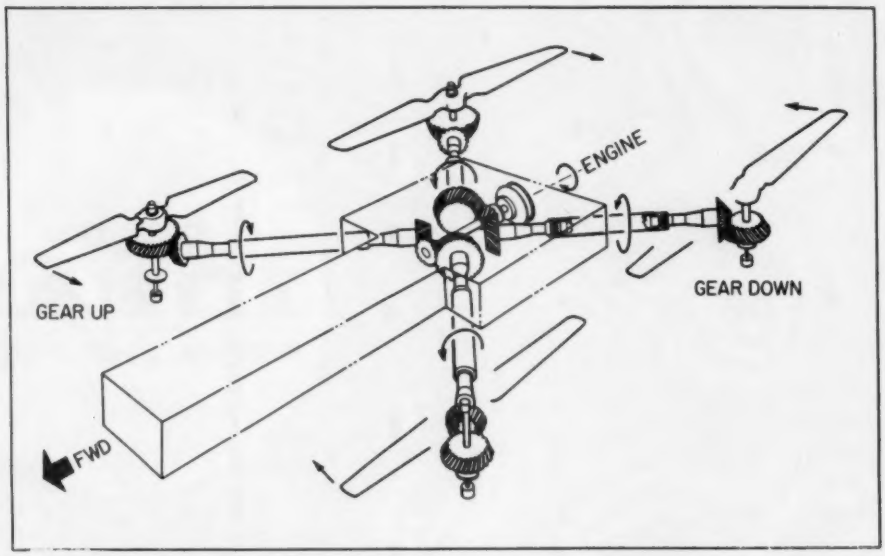
HOW WOULD YOU DRIVE, from a single power source and without weight penalties, four lifting rotors that are widely separated and positioned outboard from corners of a rectangular load-carrying platform?

This critical transmission problem faced engineers at Santa Barbara Div., of Curtiss-Wright Corp., for a new vertical takeoff aircraft, the experimental *Aerial Platform*.

It was solved by a cruciform system that uses only 14 gears to drive the four lifting rotors. A conventional helicopter with a large lifting rotor and a small anti-torque tail rotor has 23 gears in its main transmission system.

The cruciform transmission eliminates large gears and planetary groups, as well as engineering for high primary and torque loads. Power is distributed to four identical lifting rotor gearboxes. Gear reduc-

AERIAL PLATFORM in flight proves cruciform transmission, which is radical departure from conventional helicopter drive.



CRUCIFORM SYSTEM's 14 gears turn opposing propellers in the same direction by having propeller gears located both over and under the pinions.

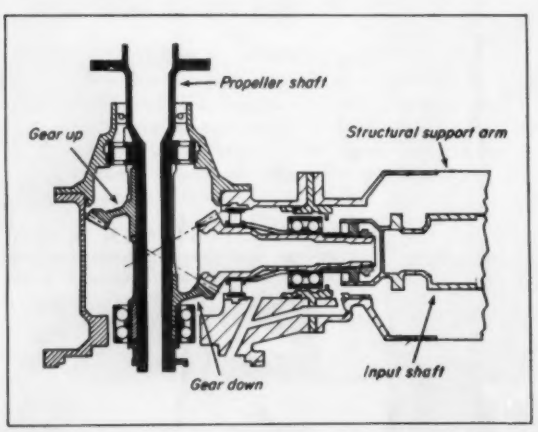
CRUCIFORM TRANSMISSION *continued*

tion is minimized because of the small 6-ft, 8-in., variable-pitch propellers rotating at 2175 rpm.

The propellers are powered from a turbine engine shaft delivering 400 shaft hp at 6000 rpm. According to Walter R. Wolf, Jr., Curtiss-Wright Project Engineer, the system could absorb up to 560 shaft hp.

The 3:1 reduction ratio compares with that of 20:1 required of a transmission for a conventional single-rotor helicopter powered by a similar turbine engine. Also, the Curtiss-Wright rotor system produces only 1/7 the torque inherent in a single-rotor helicopter, further reducing gear stress.

Two main driveshaft gears drive four transmission gears in the central gearbox of the cruciform. The driving pinions have a pitch diameter of only 2.5 in., and mesh with four transmission gears of 3.95 in. diameter. Opposing thrust of the pinion gears virtually neutralizes shaft thrust load, allowing use of a small driving shaft supported by two gearbox bearings—a roller bearing with 1⅜ in. bore and a ball bearing with 1-3/16 in. bore. In the four identical propeller gearboxes, a 3-in. pinion drives a 5.2-in. propeller gear. To drive opposing propellers in the same direction, propeller gears are placed one under, one over, the pinions.



PROPELLER DRIVE showing gear up or down detail.

Transmitting power over the distance between the central gearbox and propeller gearboxes has not caused serious vibration or whiplash. Aluminum alloy sheet metal arms (7 in. by 4 in.) extend from the platform structure to give rigid mounting for the tubular transmission shafts. They also carry the full lifting loads of the propeller gearboxes.

In each propeller gearbox, a takeoff from the propeller gear drives two gear-type pumps which deliver lubricant oil through lines drilled in the gearbox housing and at the same time supply oil for fluid powering of the hydraulic propeller pitch control system.

Basic design of the aircraft was developed by Dr. Richard Vogt during a design competition initiated by U. S. Army Transportation Research Command, which wanted a low-flying vehicle that would do the work of an Army jeep, with the added advantage of air mobility. Sargent Engineering Corp., helped with gearbox design, made the gears, and assembled and tested the gearboxes.

The aircraft's flight tests have been successful to a degree unique among VTOL (Vertical Takeoff and Landing) research vehicles. Part of Curtiss-Wright's overall plan for the program is to apply its characteristics to more advanced concepts. ▲▲▲

Master/slave drives control precise batching

COMBINATION of a variable-speed master drive and eight variable-speed slave drives provides precise control over total quantity and individual ingredients of paper machine furnish—a mixture of pulps, chemicals, and colors—in a large midwestern paper mill.

It permits the amount of furnish to be varied according to the speed of the paper machine and the weight of the paper being made. It also permits the operator to vary the proportions of any of the eight ingredients by as much as a 6:1 ratio to produce different grades of paper. All this can be done without shutting down the machine.

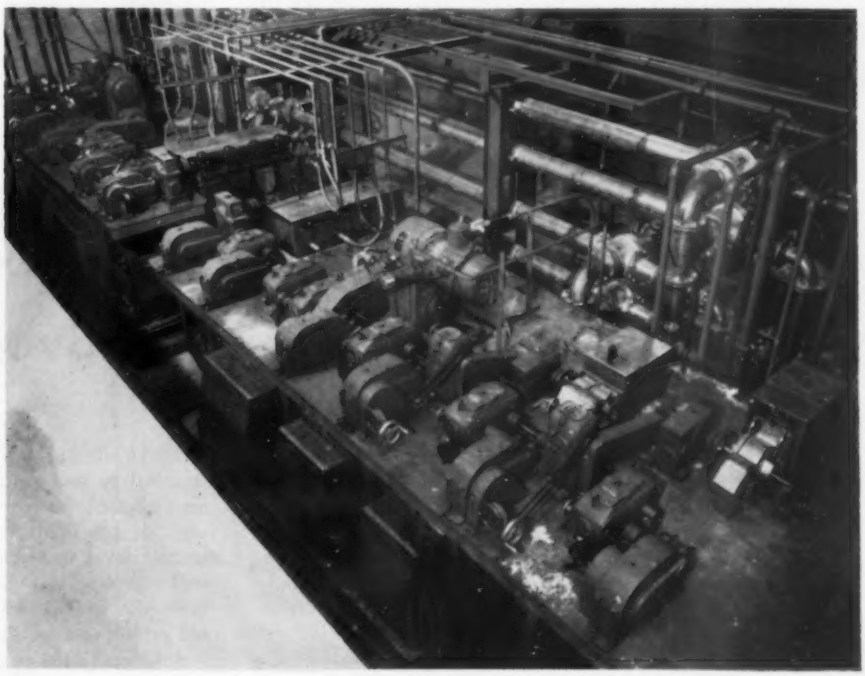
In the installation shown in the photo (actually two complete 8-meter systems), a variable-speed drive consisting of a 5-hp motor and a 4:1 speed changer is the master drive for each system. An alternate installation, shown in the diagram, uses a constant-speed motor to drive a master variable-speed drive through a 4:1 speed range with a V-belt drive. An air cylinder, actuated by a level control in the furnish-receiving tank, automatically controls the speed of the motor. It also can be controlled manually.

A V-belt-driven line shaft, flexibly coupled, drives the eight variable-speed metering drives, which are rated at 1 hp. These drives operate the individual pulp meters through reducers and roller chain. A worm gear reducer drives the chemical and color meter units.

The proportioning meters are actually miniature undershot water wheels. By adjusting a handwheel on each variable-speed drive, the rpm of its associated metering wheel, and thus its feed rate, is varied. Indicator dials on the drives are calibrated and curves are available to convert speed settings to percentages of ingredients being metered. Individual motors can be mounted on the drives to do this remotely from a central panel.

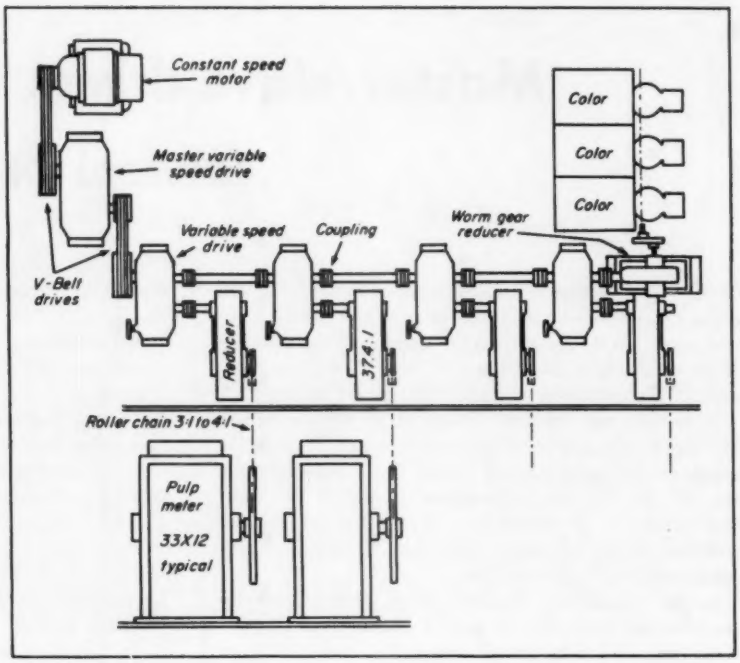
The input to the master drive is usually set at about 700 rpm by a V-belt drive between the motor and the input to the drive. The drive's 4:1 speed range proides an output speed ranging from 350 to 1400 rpm.

There's further reduction from the master drive to the individual drives to provide input speed at these drives of 400-500 rpm when the master drive is at its midpoint. This then produces a speed range of from 200 to 1200 rpm at the individual drives,



MASTER DRIVE shown here is a 5-hp motor and a 4:1 speed changer. There are two complete 8-meter systems.

IDEAS
continued



ANOTHER SYSTEM's master drive is a constant-speed motor driving a master variable-speed drive through V-belts.

MASTER/SLAVE DRIVES *continued*

which can be further altered by the master drive.

The output speeds of the individual drives are further reduced by 37.4:1-ratio spur gear reducers, and reduced again by roller chain drives with reduction ratios of 3:1 to 4:1.

It's possible for a pulp meter to run from ½ rpm to 12 rpm, a speed range of 24:1. This includes a 6:1 range through the individual drives and 4:1 through the master drive. Changes of proportions of pulp ingredients can be done only in the 6:1 range; the 4:1 range controls the total amount of furnish being fed.

The chemical meters, which are smaller than the pulp meters, operate from ¾ rpm to 18 rpm. Although the 6:1 range on the chemical drives is usually enough, sometimes a greater proportioning range is required. So, a special speed changer installed on the drive provides an adjustment range of 20:1.

This proportioning system was developed by Trimbey Machines, Inc., Glen Falls, N. Y. ▲▲▲

Differential gear case redesign improves lubrication

DYNAMOMETER tests run on the drive train of a large off-highway truck in development showed that lubrication of the differential pinion bearings was not too good. High differential oil temperature was one of the ways this was discovered. Further investigation to discover the cause and cure was done with a standard rear axle modified by the addition of clear acrylic plastic sight holes.

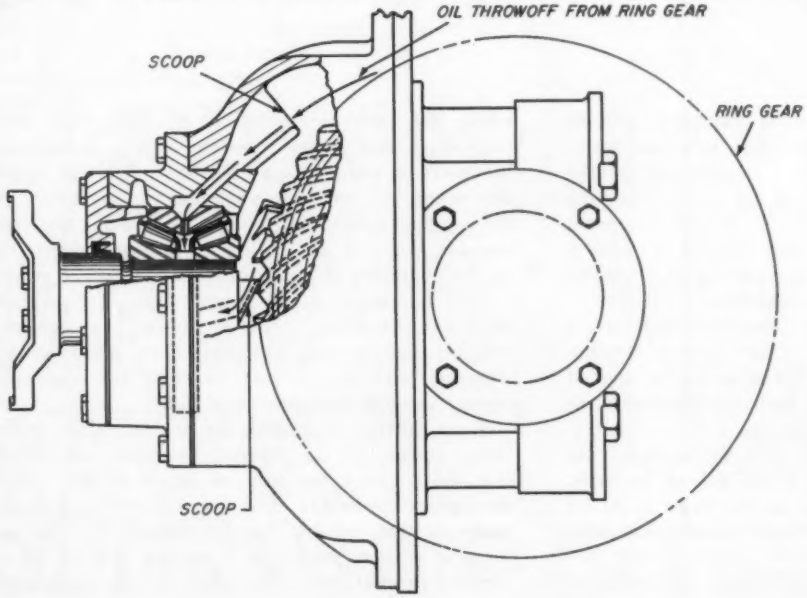
The specially-prepared axle was motored at various speeds while various oil levels were tried in the differential to see which level was needed to maintain an acceptable temperature level. A thermocouple was used to continuously measure oil temperature. The correct level was found by this method, but it was still obvious just from looking through the sight holes that the differential pinion shaft bearings were not getting enough oil.

Solution to the problem is two oil scoops added to

REDESIGNED differential improved lubrication of bearings on the differential pinion shaft of this large off-highway truck.

the inner surfaces of the differential carrier castings. The upper of the two scoops catches oil thrown off the top of the ring gear as it revolves. This oil is then directed to the front differential pinion shaft bearings. These are tapered roller bearings installed adjacent to each other. The other scoop is placed at a lower level to trap and hold oil for instant lubrication of these bearings when the truck starts up after it has been standing for a fairly long time.

Subsequent testing by the maker of the truck, International Harvester Co., Chicago, Ill., at their proving grounds in Arizona proved the soundness of the redesign. The original work was done on the International Model 65 Payhauler, a 19-ton capacity, off-highway, rear dump truck powered by a 250-hp diesel engine. The same differential design is also used on the Model 95 Payhauler, a 27-ton capacity rear dump powered by a 375-hp diesel. ▲▲▲



SECTION through redesigned differential shows added oil scoops.

IDEAS
continued

HIGH-SPEED magnetic tape drive helps computer read or record 96,000 decimal digits a second. Vacuum virtually eliminates damage to tapes.

Vacuum capstan drive is instant start-stop

COUNTER-ROTATING vacuum capstans provide split-second control of magnetic tape in a tape transport system. This vacuum drive starts the tape moving within .001 second and gets it up to full running speed of 120 ips in .0027 seconds after the command to start. It stops the tape in less than .3 in. after a stop command. More than 180 start-stops a second can be made under continuous operation.

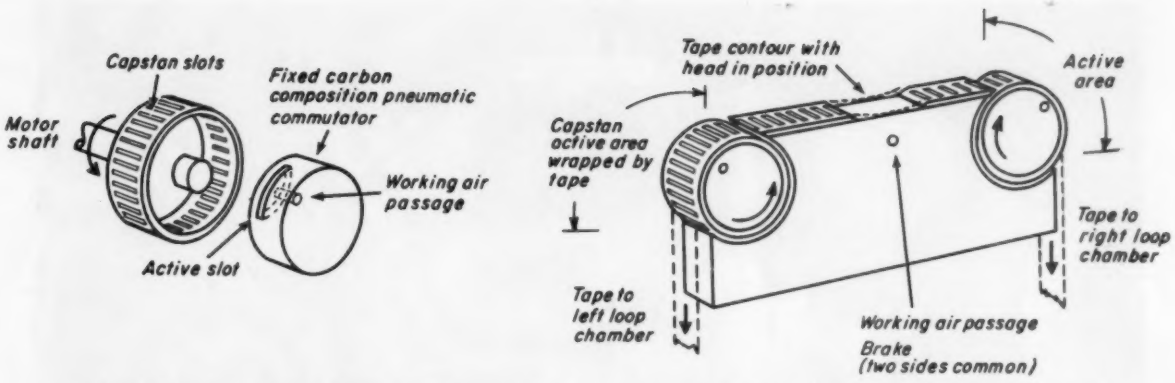
The drive capstans, each shaft-mounted on a hysteresis synchronous motor, are rotated continuously in opposite directions. Vacuum can be applied to either capstan, but not to both simultaneously, to provide the suction that grips the tape.

Each capstan is like a cup, with its perimeter cut by evenly-spaced slots parallel to the axis of the shaft. The slots are nearly as wide as the capstan on its outer surface, but narrow down to small rectangular openings on the inside.

The capstans rotate around fixed commutators, which are carbon-composition cylinders that pneumatically connect their capstans with a compressed air reservoir and a vacuum reservoir. A single central slot spans 90° of each commutator's perimeter. As the capstans rotate, their slots passing along the commutator slot pick up suction or pressure, depending on the condition of a pair of electropneumatic valves.

With no current in the magnet coils of the valves, their flat armatures, resiliently pivoted near one end, seal off the vacuum seat and allow air from the pressure reservoir (2 psi) to enter the associated capstan through the commutator slot.

When current is applied, the armatures are pulled down, sealing off the pressure reservoir and permitting the vacuum reservoir to apply suction (half-atmospheric pressure). The electrical connections are made so that current can be applied to only one valve at a time, producing a suction only in its associated capstan, while the other receives compressed



VACUUM CAPSTAN (left) gets suction or compressed air through air passages in commutator. Suction through capstan slots drives tape; compressed air provides lubrication when capstan is not driving. The brake, slotted sections on either side of the head (right) works on suction. When brake goes on, both capstans get pressurized air, so neither one can work against the braking action.

air. When no current is applied to either valve, both capstans receive slightly pressurized air.

With this arrangement, the magnetic tape is gripped pneumatically by a 90° sector of the driving capstan, while it floats on an air cushion over the other, counter-rotating capstan. At the command of stop, both capstans receive pressurized air, floating the tape off the capstans. Simultaneously, vacuum is applied to the brake, which is a stationary, slotted surface located between the capstans and under the magnetic reading head.

For rewind, vacuum is applied to the left-hand capstan, pressure to the right. The left-hand motor automatically goes to 3600 rpm for high-speed tape transport (360 ips) during rewind.

Since the capstans rotate continuously, tape movement begins almost instantaneously with the application of suction. The only inertia that must be overcome is that of the tape itself. The tape's oxide (message-bearing) surface is uppermost, so it never comes in contact with the capstans or brake. Tape is therefore clean, lasts longer.

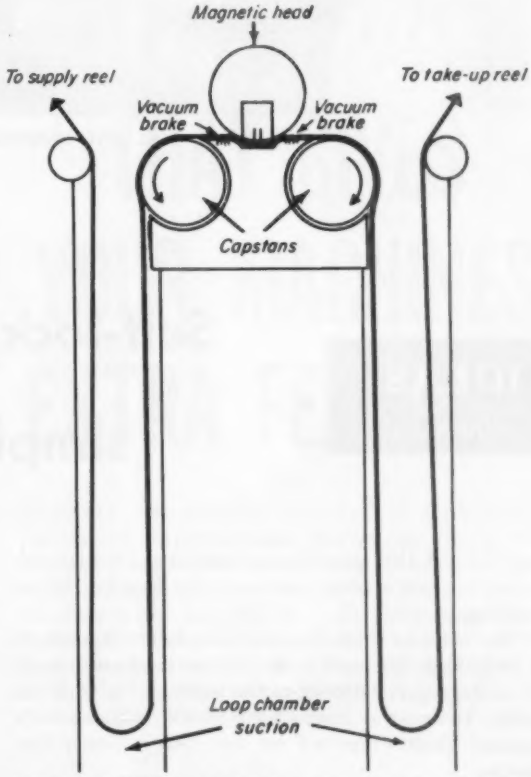
With other tape transport drives, such as pinch rollers or friction drives, there is inertia and the possibility of embossing wear particles or other dirt into the tape.

Tape accelerating forces in the pneumatic drive are spread over a large area to minimize tape stresses. Symmetrical engagement of the tape to the capstan or brake is assured by the symmetrical design of the pneumatic passages, with engagement always beginning along the tape center line and then spreading to the sides. This all but eliminates skewing of the tape.

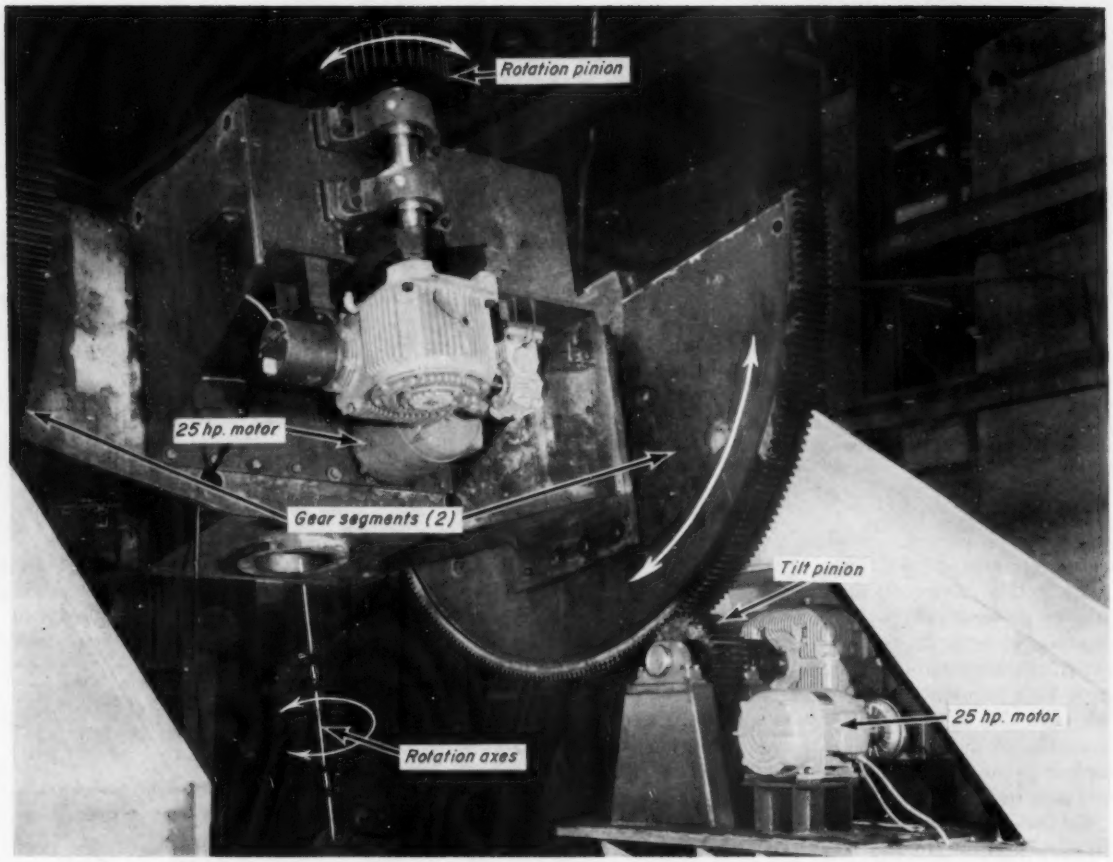
The pneumatic system also provides complete edge guiding of the tape over its entire path, from the supply reel to the takeup reel. Other drives require flanged rollers, with the tape unsupported over important portions of its path.

The two hysteresis synchronous motors operate off 60 cycle ac. The left-hand (rewind) motor is a two-speed (1200/3600 rpm) unit, rated at 1/20 hp. The right-hand (takeup) motor is rated at 1/15 hp.

The pneumatic drive was designed by Datamatic Div. of Minneapolis-Honeywell Regulator Co. for its Honeywell 800 tape transport system, which can read or record information at the rate of 96,000 decimal digits a second. ▲▲▲



TAPE PASSES THROUGH vacuum loop chambers which control tension and give edge guiding. Note that the oxide, or message-bearing, surface of the tape never comes in contact with capstans or brake.



WELDING POSITIONER with table removed.

IDEAS
continued

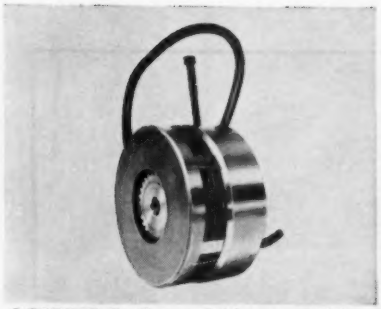
Self-locking drives simplify 2-axis positioning

SELF-LOCKING gear drives rotate and tilt the work table in a new welding positioner that handles 100-ton weldments.

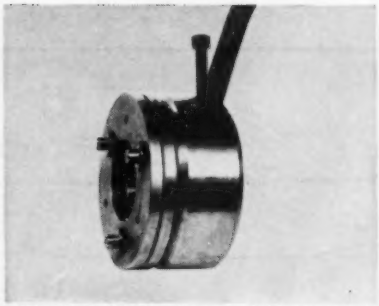
The rotation drive handles a rotational moment of 1,680,000 in.-lb caused by the 100-ton load and is made of a large gear fastened to the bottom of a 20-ft dia table. The gear is driven by a pinion mounted on a counter shaft supported by two heavy duty pillow blocks.

The design prevents high overhung loads from being transmitted to the output shaft of the worm reducer which drives the pinion. This reducer is double-enveloping type with a reduction ratio of 60:1 and *has a very low helix angle to make it self locking* against load induced turning torques. It is driven by another reducer of the same type with a 15:1 ratio and double extended input shaft. One end of the input shaft connects to a solenoid-operated brake while the other is driven through a fluid coupling by a 25-hp, 1750-rpm, induction motor. The fluid coupling limits inrush current to the motor with this high inertia load.

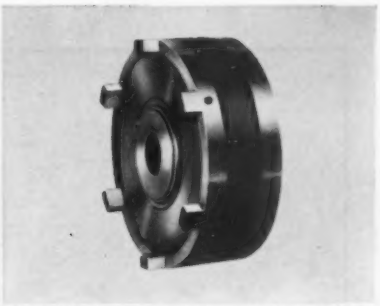
The tilt drive is two trains, each almost identical with the rotation drive. The two trains divide the 8,100,000 in.-lb tilting moment. Fluid couplings in these



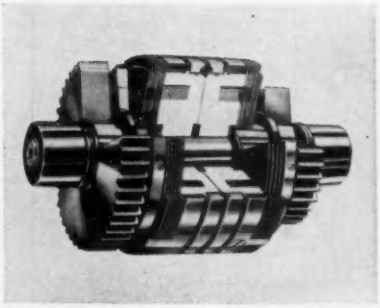
S SERIES. Stationary field, external drive, unit assembly. No brushes.



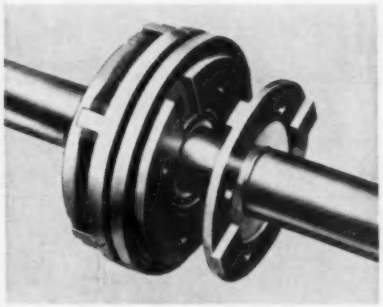
SF SERIES. Stationary field. Serrated face tooth.



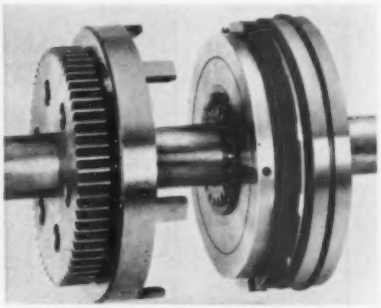
F SERIES. Serrated face tooth. Provides high torque in small space.



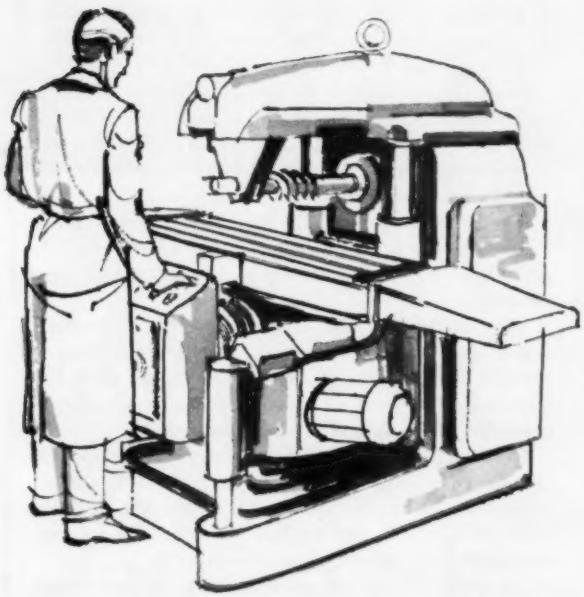
STANDARD. Internal drive. Magnet body rotates with shaft.



B SERIES. Magnet body rotates with shaft. Usually used as a brake.



C SERIES. External drive permits unit assembly. Facilitates machine assembly.



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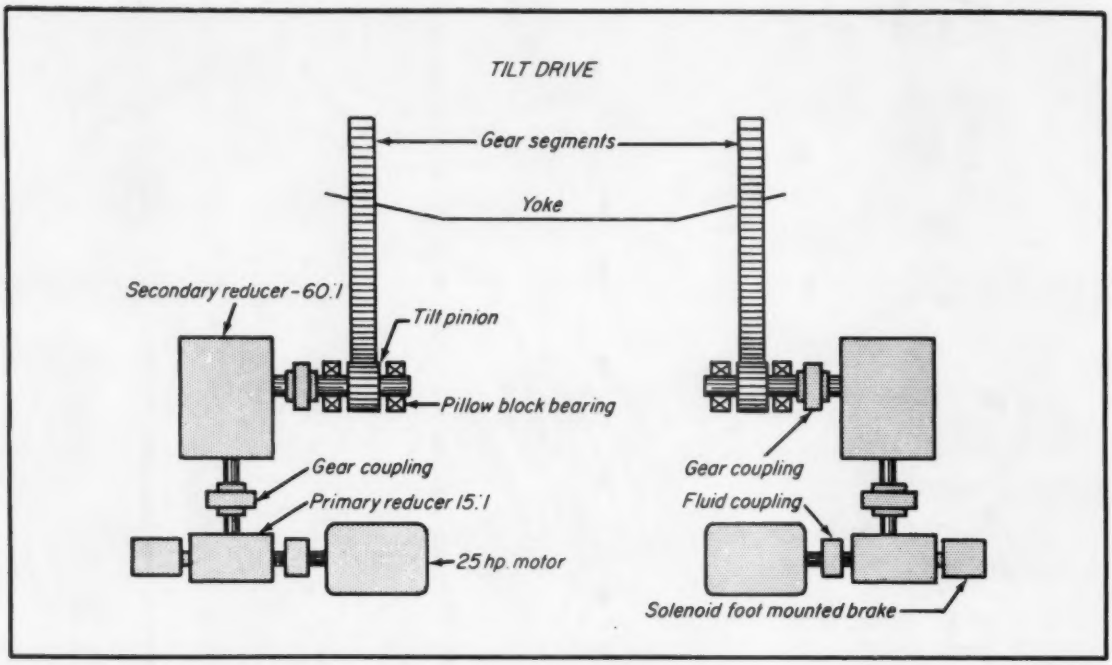


TILT DRIVE TRAIN SCHEMATIC

SELF-LOCKING DRIVES *continued*

systems equalize the load between the two branches and synchronize their speeds. They also keep inrush currents down when starting.

Initial thought when designing the tilt drive train was to use a single motor and drive through two reducers to a countershaft on which the two pinions driving the two gear segments would be mounted. However, the countershaft must carry bending and torsional loads. Additionally, the shaft must be sized so torsional deflections to either side of the power input point will be equal. Otherwise each gear segment will not pick up its fair share of the load.

Since this balance is always doubtful, the gear segments are designed to handle a 50% overload. The dual drive automatically balances to eliminate the heavier-than-needed gearing and the long, heavy, torsionally-balanced shaft.

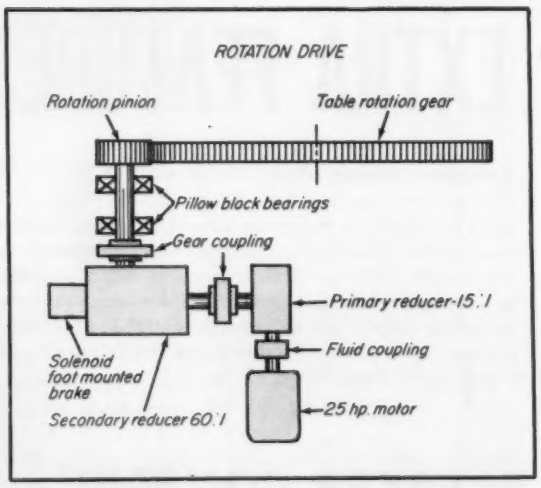
Another advantage of the dual drive is elimination of expensive machining of the frame which would be necessary to insure proper alignment and gear meshing.

This method is also economical since standard, rather than custom-made, units can be used. Cost of the two 25-hp drives is only a little more than half what one 50-hp drive would cost. *Dual drives made disassembly, shipping and erection much easier.*

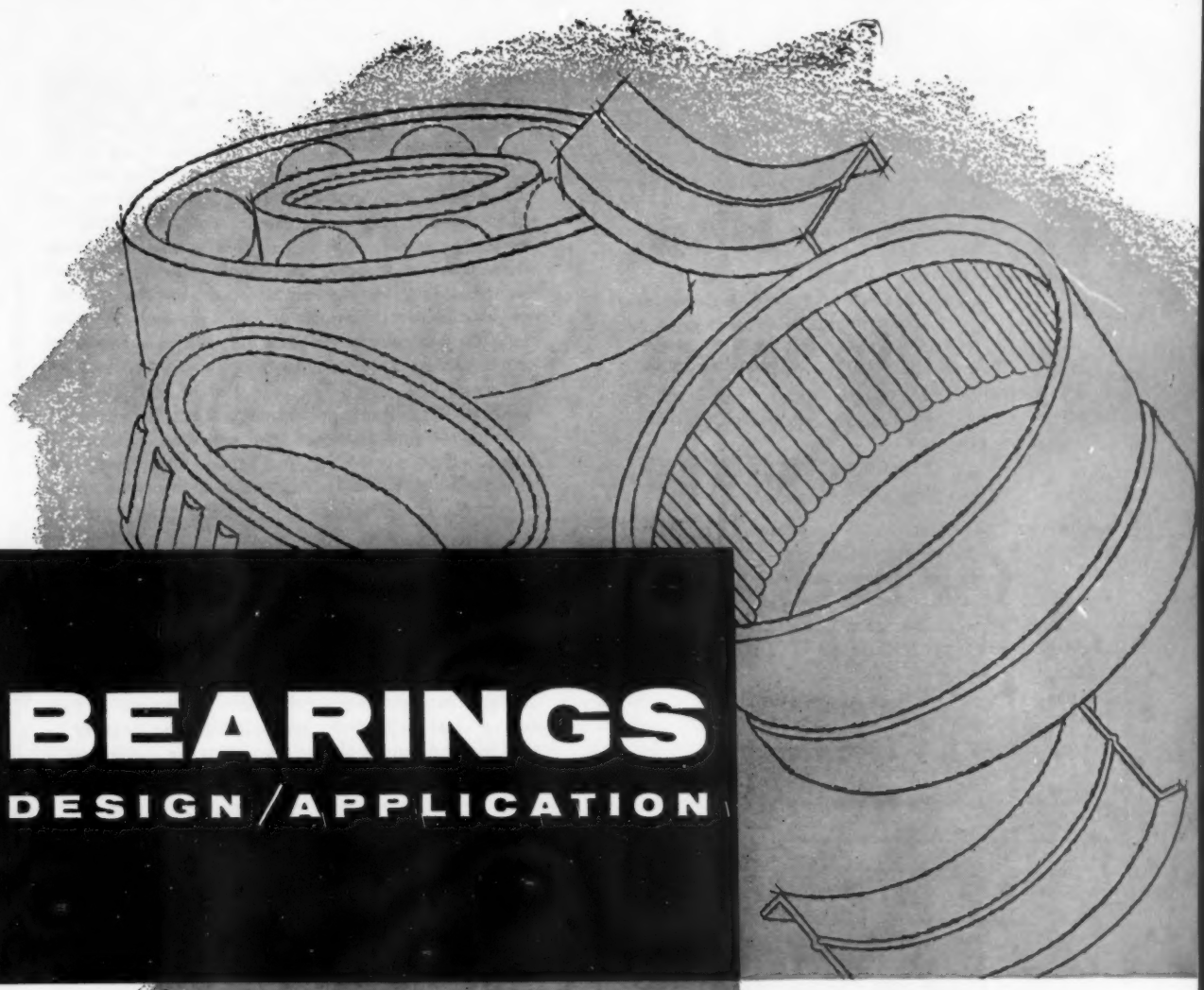
Overhauling loads due to off-center positioning of the work-supporting table and the work piece complicated the design. The weldment rotates through 360 deg about its axis and the table tilts through approximately 135 deg around a horizontal axis.

The load goes over center and, due to its own weight, attempts to move table and load to a bottom dead center position. This cannot be allowed because it would jeopardize the welders and make it impossible to maintain a constant rotational speed of the table for automatic welding.

This unit was designed for the Bucyrus-Erie Co., South Milwaukee, Wisc. by the Ransome Co., Scotch Plains, N. J. ▲▲▲

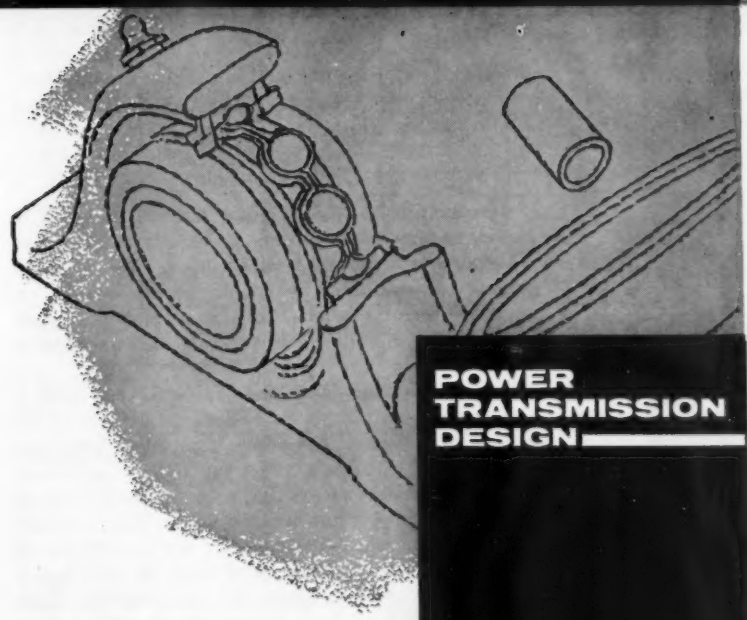


ROTATION DRIVE TRAIN SCHEMATIC

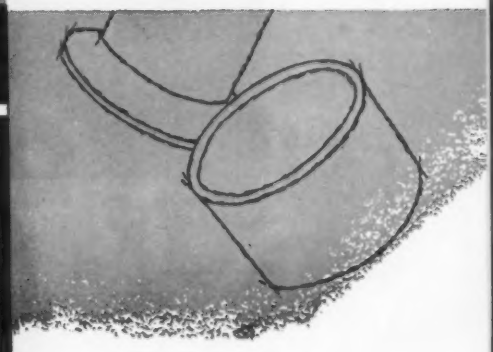


BEARINGS

DESIGN/APPLICATION



REGULAR MONTHLY SECTION OF IDEAS AND DEVELOPMENTS



POWER TRANSMISSION DESIGN

How to select grease for bearings

- properties
- specifications
- tests

N.L.G.I. No.	Worked Penetration No.
0	385 - 355
1	340 - 310
2	295 - 265
3	250 - 220
4	205 - 175
5	160 - 130
6	115 - 185

TABLE 1: Penetration and corresponding N.L.G.I. numbers.

LUBRICATING GREASES are solid to semi-fluid products composed of oil and thickening agents. The amount of thickening agent determines, to a great extent, consistency of the mixture. The type of agent also affects consistency, but gives other qualities too.

The most important difference between grease and oil is consistency. Since grease is semi-fluid or plastic, it does not run like oil and, therefore, tends to remain where it is put. It does, however, flow in the direction of motion in a bearing and lubricates in the same way oil does. Grease has much higher adhesive properties than oil. This means that more pressure is needed to squeeze a grease film into and out of two bearing surfaces.

Grease is good on applications not readily accessible to lubricant replenishment. The sealed-for-life bearing is probably the best example of this. Other cases, such as automobile wheel bearings, use a supply of grease that needs replenishing only at fairly long intervals.

Grease works well in oscillating bearings where there is no continuous rotary motion of the journal in the bearing. Under these conditions, hydrodynamic lubrication cannot exist and grease will do a much better job than oil because of its thicker film and higher adhesion.

Simplified sealing: Grease forms an effective seal that prevents entrance of dirt into a bearing. It does not necessarily have to be sealed in the bearing to stay in. Under normal operation, it stays put and only the simplest seals are needed.

How Grease Lubricates

Grease becomes fluid when sheared, or worked, in a bearing. Therefore, the bearing is actually lubricated by an oily film at points of contact. But, where the grease is not being sheared, as at the edges of the bearing, it remains a semi-solid, and therefore, continues to do its sealing job.

In some bearings, it is thought that lubrication is performed by oil which bleeds from the main body of the grease to the moving surfaces. There are also indications that the grease itself may flow to the bearing due to heating, vibration and temperature.

Dropping Point

Temperature at which grease melts or changes to liquid from semi-solid state is the dropping point. This point is important because it is a measure of the highest temperature at which the grease may be expected to perform satisfactorily. Some oil will separate or bleed from some greases before the whole mass melts.

In the dropping point test, a special cup with a standard size opening in the bottom is used to hold the sample to be tested. The cup is completely filled and a metal rod is rotated in the cup to remove a cone of grease and leave only a film adhering to the sides of the cup. The cup is put in a test tube which is in turn put in an oil bath. A thermometer is placed in the oil bath and another is positioned with its bulb inside the test cup but not touching the grease sample. Temperature of the oil bath is then raised until a drop

falls from the opening at the bottom of the cup. Both thermometers are read at this moment. The average of the two readings is the dropping point.

Penetration

Consistency of grease is important because it is a measure of how easily grease may be squeezed out from between the parts being lubricated. Also, it is a measure of the resistance to motion the grease offers in an antifriction bearing. Grease with too high consistency in an antifriction bearing may offer more resistance to the motion of the bearing than the friction it is supposed to reduce.

Consistency is measured by dropping a standard metal cone point downward into a grease sample. The amount of cone penetration to the closest tenth of a millimeter is then determined (one-tenth millimeter is approximately 0.004 in.). The National Lubricating Grease Institute (N.L.G.I.) has set up a system of numbers for expressing grease consistencies. Each number corresponds to a particular range of penetration numbers, Table 1.

Samples to be tested for penetration are first prepared by working, or kneading. This is necessary because consistency can be radically changed by working. Since grease in service is worked by the motion of the parts it lubricates, the worked penetration number is a much better measure of the consistency of grease in use.

Grease consistency is also measured by a method called apparent viscosity. Here, a hydraulic system forces the grease through a capillary. Apparent viscosity is calculated from the flow rate and pressure required to produce flow. This test is important when the grease is to be pumped in an automatic lubrication system. Also, it is a measure of starting and running torque required to overcome the resistance of the grease to motion in a bearing.

There are many other grease tests. Most of them, however, do not measure things that affect performance. They are used to measure quantities of contaminants in used greases and for manufacturing control.

Thickening Agents

Thickening agents used to make grease from oils largely determine the characteristics and applications. Most thickening agents are metallic soaps. These soaps include: calcium, sodium, aluminum, barium, and lithium soaps. Some greases use solids such as silica, carbon black, finely divided clay, and clay derivatives. Table 2 shows how the characteristics of greases vary with thickener and also includes usual applications or uses for the different types. ▲▲▲

PROPERTY	THICKENER							
	CALCIUM SOAP	CALCIUM-RESINATE SOAP	HIGH-MELTING POINT CALCIUM SOAP	SODIUM SOAP	SODIUM-CALCIUM SOAP	ALUMINUM SOAP	LITHIUM SOAP	SOLID THICKENER
Texture	Buttery	Buttery	Buttery	Fibrous or smooth	Buttery to fibrous	Buttery to stringy	Buttery to stringy	Buttery to stringy
Highest continuous usable temperature	175 F	200 F	225 F	300-400 F	250 F	150 F	300 F	Depends on oil
Dropping point	200-225 F	275 F	280 F	300-450 F	315 F	200 F	360 F	500 F+
Reaction when heated above melting point and then cooled	Separates unless chemically stabilized	Separates	Separates	None if worked	None if worked	Texture changes, does not separate	None if worked	Retains texture, but may harden
Water resistance	Good	Good	Good	Poor to fair	Poor to fair	Good	Good	Good
Resistance to work softening	Poor to fair	Poor to fair	Excellent	Poor to excellent	Poor to excellent	Poor to fair	Poor to excellent	Poor to excellent
Application	Plain bearings	Heavy bearings at low speeds	Ball, roller and plain bearings automotive & industrial	Ball & roller bearings at low to medium speeds, vehicle bearings & chassis	All types of ball & roller bearings at high & low temperatures, depends on Ca-Na percentages	Special applications where high adhesion, resistance to centrifugal throw-out are needed	Aircraft @—100 to +300F also automotive & industrial	For high temperatures

TABLE 2: How Grease Properties Vary With Thickener.

ANNOUNCING A NEW CORPORATE NAME

for The Garlock Packing Company

Garlock Inc. becomes the new name for The Garlock Packing Company, Palmyra, N. Y., to reflect more accurately its broad diversification of products and markets.

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The new corporate name, Garlock Inc., more closely identifies this 73-year-old company with the growth and development of its product lines. *Today, industry goes to Garlock for such widely diversified products as:*

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- Braided Packings
- Molded and Extruded Rubber Parts
- Plastic Stock Shapes and Fabricated Parts
- Mechanical Seals for Rotating Shafts
- Metal Packings
- Leather Packings
- Electronic Components
- Dry Bearing Materials
- Fluorocarbon Tank Linings
- Missile and Rocket Components

To help you in selecting or applying these products, Garlock offers the services of over 126 thoroughly-trained sales engineers, 175 electronic component manufacturers' representatives, 180 authorized bearing distributors and 69 foreign distributors. Conveniently located warehouses and stocking points assure Garlock customers of prompt delivery.

At Garlock Inc., design and development of new or improved products and materials is an ever-present objective. To this end Garlock maintains extensive research and laboratory-test facilities. In addition, Garlock engineers and chemists are always ready to work with you in seeking solutions to tough application problems.

GARLOCK

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Plastic Stock Shapes
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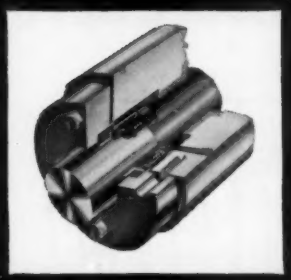
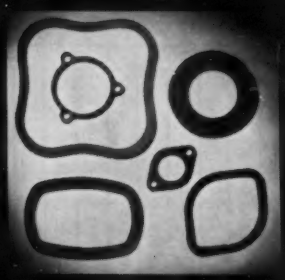
Braided Packings

Fluorocarbon Tank Linings

Oil and Grease Seals



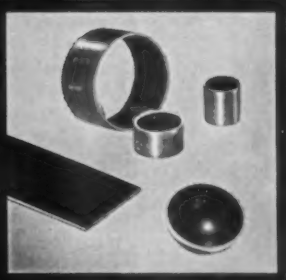
Mechanical Shaft Seals



Gasketing

Spiral Wound Gaskets

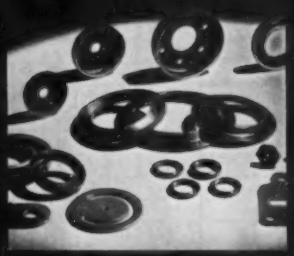
Metal Packings



Dry Bearing Material

INC.

Missile and Rocket Components



Leather Packings

Electronic Components

How to decide which type bearing to use

By A. O. DeHART, research engineer, Research Laboratories, General Motors Corp.

ROLLING ELEMENT BEARINGS include many types of ball, roller, and needle bearings. Starting friction of rolling contact bearings may be much less than that of hydrodynamic bearings, but running friction of the two types is comparable.

Externally-pressurized bearings can be made so that friction is very close to zero as relative velocity of bearing with journal approaches zero. So, although rolling contact bearings do reduce friction, they are not *antifriction* any more than other types.

Rolling elements are: cylinders, balls, tapered rollers, barrels, or very slim rollers known as needles. The whole bearing generally gets its name from the shape of the rolling elements.

Table 1 Selection Factors

RELATIVE RATING

G good
I intermediate
P poor
N none
D does not apply
NA not available or known

SELECTION FACTORS	Ball						Roller						Journal						External psi ⑤	
	DEEP GROOVE	DEEP GROOVE — FILL SLOT	ANGULAR CONTACT	2-ROW ANGULAR CONTACT	SELF ALIGNING	THRUST	CYLINDRICAL	CYLINDRICAL — LOCATING	BARREL	SPHERICAL THRUST	TAPERED	NEEDLE	FULL	PARTIAL	AXIAL SLOTTED	ELLIPTICAL	THREE-LOBED	PIVOTED SHOE	CAPILLARY ⑥	VARIABLE FLOW DAM ⑥
LOW STARTING FRICTION	I	I	I	I	I	I	I	I	I	I	I	I	P	P	P	P	P	P	G	G
LOW RUNNING FRICTION	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	G	I
LOW NOISE	P	P	P	P	P	P	P	P	P	P	P	P	G	G	G	G	G	G	G	G
SMALL DIAMETER ①	P	P	P	P	P	P	I	I	I	I	I	G	G	G	G	G	G	I	I	I
SHORT LENGTH ①	G	G	G	I	G	G	G	G	G	G	G	I	I	I	I	I	I	I	I	I
HIGH ACCURACY	I	P	G	G	I	I	I	I	I	I	I	I	P	P	P	P	P	I	G	G
MOST AVAILABLE	G	G	G	G	G	G	G	G	G	I	G	G	G	G	P	I	P	P	P	P
HIGH RADIAL LOAD ②	I	I	I	I	I	N	G	G	G	N	G	N	G	G	I	I	I	I	I	I
HIGH THRUST LOAD ②	I	P	G	G	P	G	N	P	I	G	G	N	N	N	N	N	N	N	I	I
HIGH DYNAMIC LOAD ②	I	I	I	I	I	I	G	G	G	G	G	G	G	I	I	I	P	I	I	I
TOLERATE MISALIGNMENT	I	I	I	P	G	I	P	P	G	G	P	P	I	I	I	I	I	G	I	I
TOLERATE DIRT	I	I	I	I	I	I	I	I	I	I	I	I	G	G	G	G	G	G	P	I
LOW INITIAL COST	I	I	I	I	I	I	I	I	I	I	I	I	G	G	G	I	I	P	P	P
HIGH SPEED	G	P	G	I	I	P	G	G	P	P	P	P	I	I	I	G	G	G	G	I
HIGH TEMPERATURE ③	I	NA	NA	NA	NA	NA	I	NA	NA	NA	NA	NA	P	NA	NA	NA	NA	NA	NA	NA
SIMPLE LUBE. SYSTEM	G	G	G	G	G	G	G	G	G	G	G	G	I	I	I	I	I	I	P	P
HIGH STABILITY ④	D	D	D	D	D	D	D	D	D	D	D	D	P	P	I	G	G	G	G	I
EASY FOR DESIGNER	G	G	G	G	G	G	G	G	G	G	G	G	G	G	I	I	I	P	P	P

① with a given load (radial or thrust) ② with a given size ③ above 450°F ④ applies to high-speed fluid-film bearings ⑤ journal or thrust type
⑥ restrictor controlled (liquid)

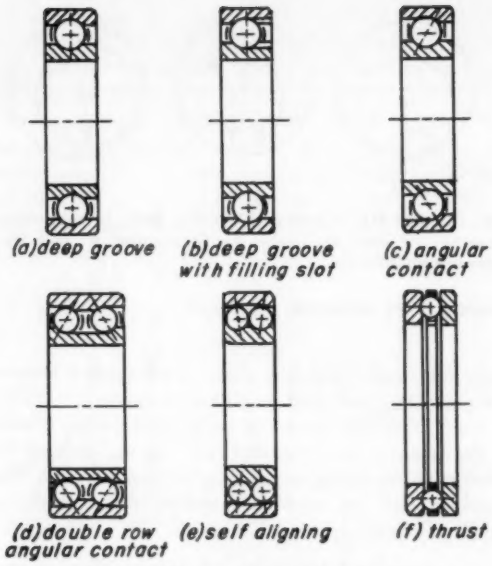


FIG. 1. STANDARD BALL bearings.

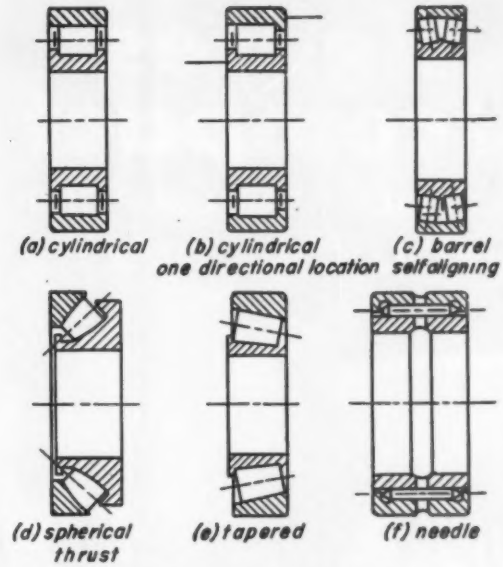


FIG. 2. STANDARD ROLLER bearings.

Ball bearings: Different types are shown in Fig. 1. Deep groove ball bearing is the most versatile. Radial and thrust load capacities are almost equal. With proper separator, it is very good for high-speed. At low speeds, no separator is needed; at intermediate speeds, a ball control separator of steel ribbon is adequate; ultimate highspeed performance is obtained with a race controlled, or piloted, fully-machined separator.

Number of balls is limited in this bearing because balls are put in by eccentric displacement of the races. Use of a notch or filling slot in one of the races lets more balls be put in. This increases radial load capacity but reduces high-speed and thrust capacity.

Large thrust loads in one direction only are best handled by angular contact ball bearings. High-speed, precision spindles usually use two of these, back-to-back or face-to-face. Preload is controlled by spacers. Double-row, angular-contact bearings have built-in preload.

Self-aligning ball bearings, unlike the others, can handle considerable misalignment. However, load-carrying capacity is reduced due to difference in curvature between balls and outer race.

Roller bearings: Higher loads can be supported by roller bearings, Fig. 2, because contact area between races and the rolling elements is higher than in ball bearings. Different constructions for radial, thrust and combined loads are available.

Cylindrical roller bearings take radial loads and permit some axial shaft motion. Addition of shoulders to the races lets them take light axial loads.

Spherical roller bearings are self aligning. Load-carrying ability is high. These bearings are normally available only in large sizes.

Tapered roller bearings are available in a full range of sizes. They will take radial and thrust loads. They are usually mounted in opposing pairs to locate the shaft under any type of load.

Needle bearings have long, thin rollers and require minimum radial space. To use the least possible space, needles may be run directly between shaft and housing. At low speeds no separator or guide is required. At higher speeds, skewing of the needles can cause trouble and a central guide, or complete separator, is used. Some loss of radial load carrying ability results.

Fluid Film Bearings

Known variously as plain bearings, journal bearings, sleeve bearings, and sliding bearings—these are the most widely used and least understood of the bearing types. Viscous fluid friction is substituted for the rolling friction of rolling contact bearings or the sliding friction of unlubricated bearings, Fig. 3. With a

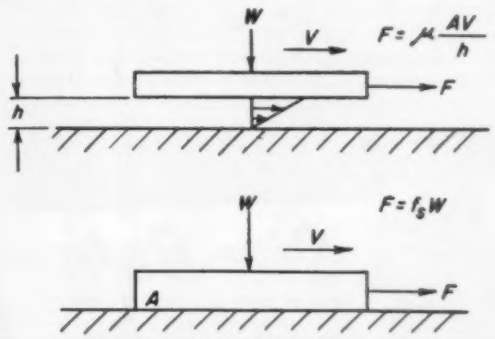


FIG. 3. FLUID FILM lubrication vs. sliding friction.

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FLEXIBLE GEAR COUPLING
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FLEXIBLE GEAR COUPLING
with
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Patented

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A sleeve weighing only four ounces, an entire assembly weighing only 3½ lbs.! The lightest, most compact flexible gear coupling yet! Never needs lubrication; takes up to 5° misalignment; operates to 150°F; wide range of capacities and speeds. The most important advance in couplings since Sier-Bath's flangeless design! Thirteen bore sizes available NOW from stock.

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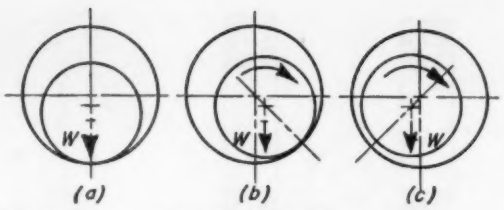

FIG. 4. FLUID WEDGE FORMATION in a journal bearing. At rest, *a*; wedge in formation, *b*, and final running position, *c*.

WHICH TYPE BEARING *continued*

fully-developed fluid film there is no contact between the parts, no wear, and no sliding damage.

Load carrying capacity of the hydrodynamic bearing is the integral over the effective bearing area of the fluid pressure acting to support the applied load. This pressure can be generated within the bearing or supplied externally.

Self-pressurized bearings: Self-generation of pressure in a bearing is either geometry induced or load induced. Most self-pressurizing bearings have geometry induced pressure. In the journal bearing, Fig. 4, the rotating shaft is slightly smaller than the bearing and the load causes it to move off center. This movement causes a converging section to be formed which, because of the viscous drag of the lubricant, induces a high-pressure region which supports the load.

A few of the many possible journal bearing configurations are shown in Fig. 5. The full-journal bearing, Fig. 5a, is by far the most widely used. Full and partial journal bearings are unstable at high speeds and light loads. Stability increases with axial-slotted, elliptical, three-lobe, and pivoted-shoe bearings. These are listed in order of increasing stability.

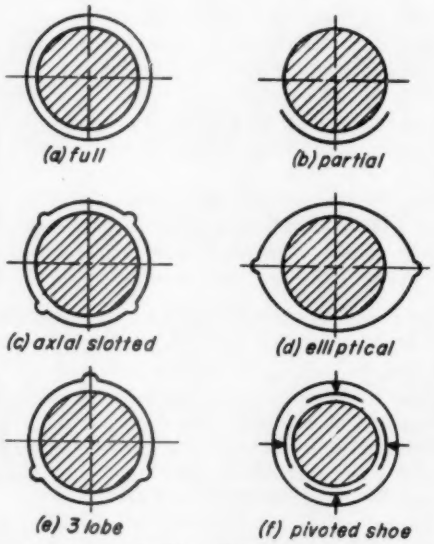

FIG. 5. TYPICAL JOURNAL bearings.

Lubricant must not only separate the bearing and journal, it must carry away heat generated by shearing the lubricant. Oil grooves and oil holes must often be used to force enough oil through the bearing to keep temperature down.

Geometry and surface finish are extremely important. Load carrying ability has been shown to increase as surface finish improves. Journal geometry has not been so well publicized but is just as important. Repetitive out-of-roundness of only 50 microin. will increase wear rate by a factor of 10.

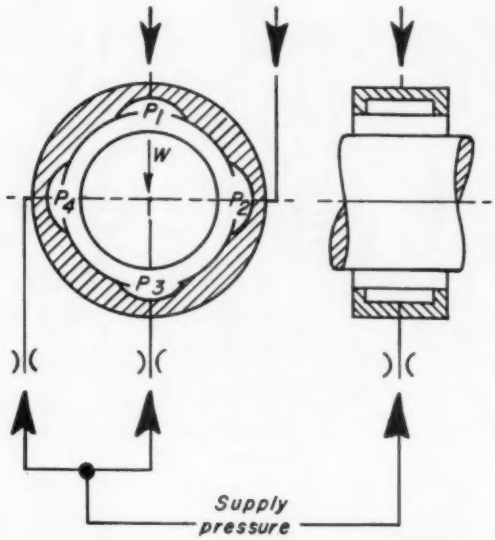

FIG. 6. TYPICAL EXTERNALLY-PRESSURIZED journal bearing.

Externally-pressurized bearings: Load-carrying ability of these bearings does not depend on the character of the load or the geometry of the bearing. A typical externally-pressurized journal bearing is shown in Fig. 6. Load carrying ability is proportional to the product of the applied pressure and the area on which it acts.

These bearings have some very real advantages and should appeal to designers. First of these is: Clearance is maintained regardless of speed. This means that they do not wear out and material selection is no problem. Furthermore, when such a bearing is used on a machine tool spindle, the running center of the workpiece is maintained when the part is gaged.

Second, at zero velocity there is zero friction. This makes these bearings ideal for use in measuring systems and dynamometers. Also, it prevents the *slipstick* friction often encountered on machine ways.

Main disadvantage of externally-pressurized bearings is the need for an external supply of high-pressure fluid, with pumps, filters and sumps. These must be designed to fit each installation. ▲▲▲

This article abstracted from a paper presented at the ASME Design Engineering Conference, Philadelphia.

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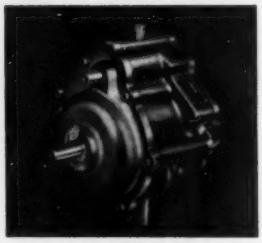
REVERSING TRANSMISSIONS

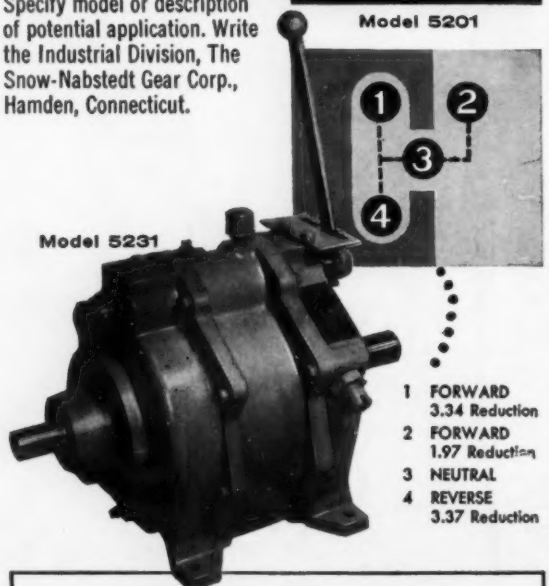
S-N



Model 5108

All designed to meet the demands for single, space saving units that reverse under full load. The newest, Model No. 5231, combines 2 speeds forward, neutral, reverse and reduction. Models 5201 and 5108 combine forward, neutral, reverse and reduction. All are performance proven. Technical literature is available. Specify model or description of potential application. Write the Industrial Division, The Snow-Nabstedt Gear Corp., Hamden, Connecticut.

Model 5201



SPECIFICATIONS

MODEL NO.	5231	5201	5108
Reduction Forward	1.97:1 & 3.34:1	3.16:1	3.75:1
Ratio Reverse	3.37:1	3.16:1	3.75:1
Power Up To	28 HP	28 HP	8 HP
Maximum Input Torque	1000 in. lbs.	1000 in. lbs.	320 in. lbs.
Maximum Input Speed	2400 RPM	2400 RPM	2400 RPM
Dimensions Long	15 1/16"	11 1/2"	9 1/16"
Dimensions Wide	14"	12 1/2"	10"
Dimensions High	14 3/4"	14 3/4"	10 3/8"

SNOW-NABSTEDT

Transmission Engineers
FOR OVER HALF A CENTURY

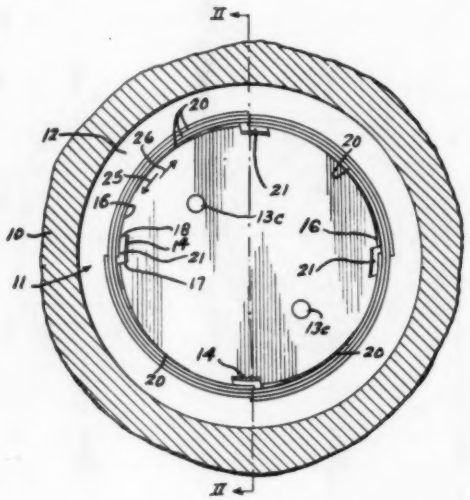
Circle No. 35 on Reader Service Card

PATENTS

Clutch

U. S. Patent No. 2,917,144; John M. Dodwell, Piedmont, Quebec, Canada

Engagement of the inner and outer races of this freewheeling clutch is effected by a spirally-wound

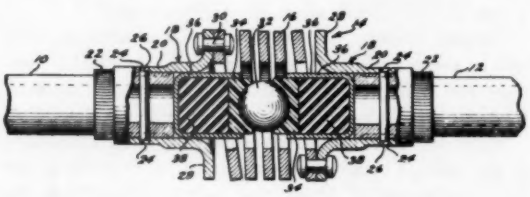


band. Outer race has a V-groove in its inner surface in which the outer end of the band lies. Inner end of the band engages axial slots in the outer surface of the inner race so relative rotation in one direction causes the band to engage both races and drive, while rotation in the opposite direction will let the band slip.

Coupling

U. S. Patent No. 2,917,910; Edward J. Herbenar, Detroit, Mich., assignor to Thompson Ramo Wooldridge, Inc.

In this shaft coupling, a torsion spring connects the two shafts. A centering ball at the center of the spring bore is supported by two concave members made of



resilient material. These members fit into cuplike metallic members which are supported in the bores of the end fittings. The cups contain additional resilient material to back up the ball seats.

Solving difficult Bearing and Special Parts Problems–

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The challenge of new and unusual problems is of continuous interest to Aetna design and application engineers. Their readiness to accept the difficult has established Aetna as a leading source for specially engineered or hard-to-make bearings, and hardened and ground precision parts.

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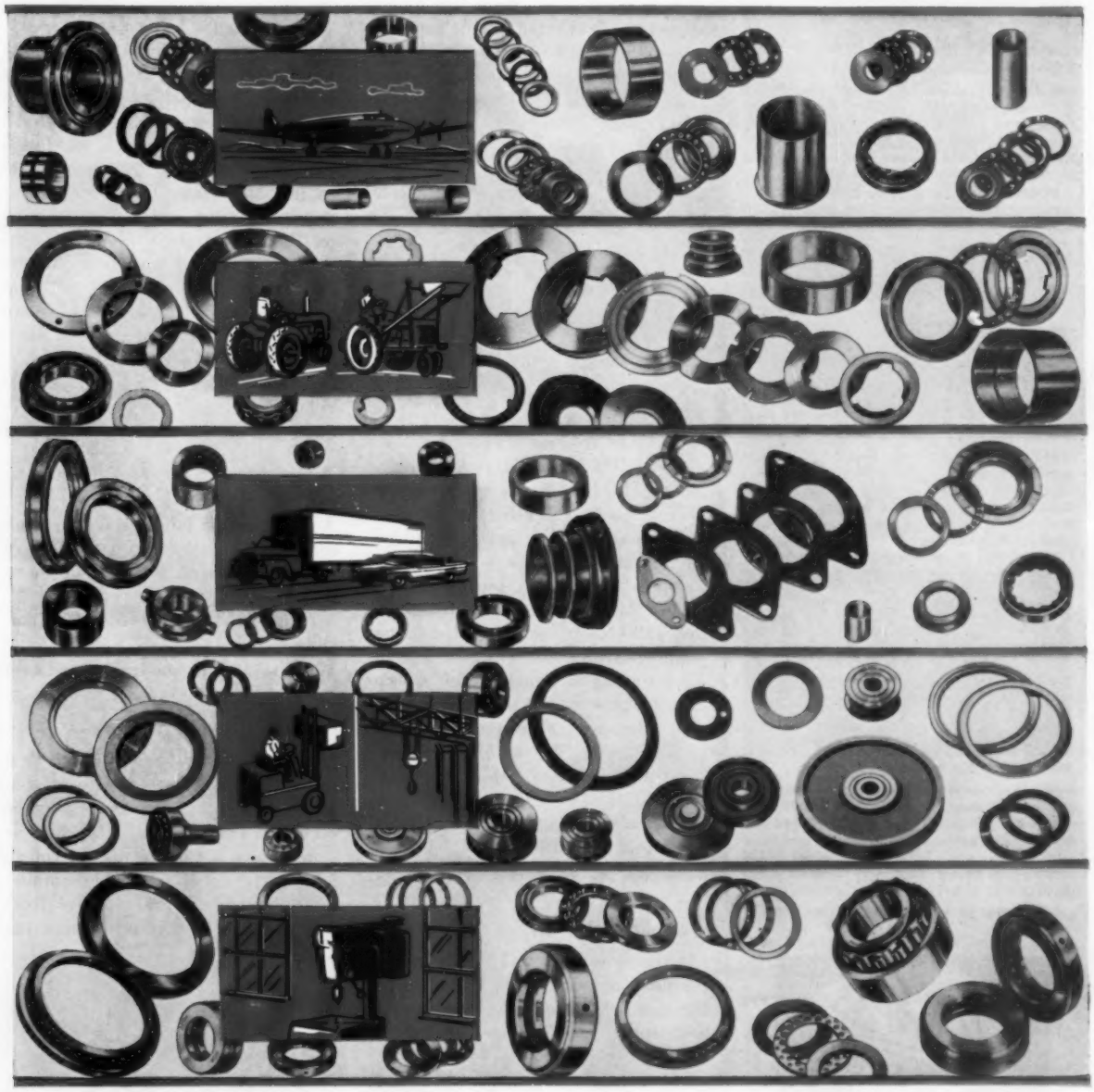

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WOOD'S POWER TRANSMISSION PRODUCT NEWS

REVOLUTIONARY NEW VARIABLE

Revolutionary resilient cam follower construction of Wood's new "MCS" motion control, variable speed drives holds constant driven speeds under varying torque loads. Like the "MS," the "MCS" won't freeze or stick. Check oil only once or twice a year. Write for Bulletins 8102, 4101.

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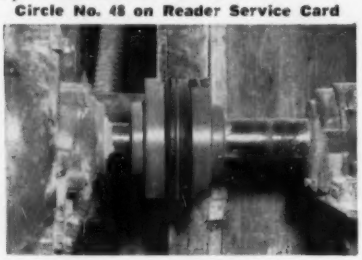

4-WAY FLEX—UNIQUE DESIGN

Wood's Sure-Flex Couplings absorb 5 to 15 times more shock and vibration than other leading flexible couplings . . . swallow all types and combinations of angular and parallel misalignment, end-float. Simple, no wear, no lubrication. Low cost. Write for Bulletin 5103.

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50% GREATER CAPACITY

New belt materials and manufacturing techniques give you 50% more horsepower from Wood's Sure-Grip V-Belt Drives. These drives are equipped with famous, interchangeable, tapered, QD-type Sure-Grip Bushings which feature standard and reverse mounting for greater adaptability. Write for Bulletin 197.

Circle No. 50 on Reader Service Card

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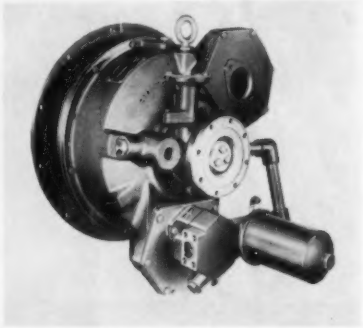
NEW PRODUCTS

To get complete information on these products, use the Reader Service Cards bound into this issue.

Sumpless torque converter

Designed for vehicles with power shift transmissions, these are single stage units in 3 input torque capacity sizes: 350 lb.-ft. (1300 series); 450 lb.-ft. (1500 series standard duty); and 650 lb.-ft. (1500 series heavy duty) Both 1300 and 1500 Series



have a PTO point for power implements. The 1300 Series has a second, lower capacity PTO that can be used for a power-steering pump. Standard on all converters is a circulating pump which directs oil through a cooler. An optional duplex pump on the 1500 units acts as circulating pump and provides a pressure head for actuating oil clutches and cooling clutch plates in the power transmission. Pumps are available in two capacity sizes. Wet or dry flywheel construction is optional on the 1500 Series.

Twin Disc Clutch Co., Hydraulic Div., Rockford, Ill.

Circle No. 200 on Reader Service Card

Coupling/slip clutch

Identified as type T 14, this in-line coupling and slip clutch is said to be the first of its kind. Design features are: spring slip torques adjustable from 0.5 oz-in. to 50 oz-in.; shaft to shaft misalignment up to .010 in.; angular misalignment to 1°, and 10 minutes maximum backlash. Units come in a wide variety of bores with both split and pin type hubs.

PIC Design Corp., East Rockaway, N. Y.

Circle No. 201 on Reader Service Card

Gearhead servomotors

A line of 400-cycle gearhead servomotors for computer and servo positioning systems. Known as Series 11, these units are 2 47/64 in. long and weigh 6 oz. Over 1000 ratios are available, from 5:1 to 78125:1, with stock ratios from 5:1 to 2000:1. All ratios are designed to a maximum recommended load torque of 100 oz.-in. Maximum backlash is less than 30 minutes with a 1 oz.-in. load on the output shaft. No-load speed is 6700 rpm and torque at stall is 0.63 oz. in. Motor housing is stainless steel, all motor laminations are nickel alloys, and precision instrument ball bearings are used.

Guidance Controls Corp., Hicksville, N. Y.

Circle No. 202 on Reader Service Card

Chain lubricant

A liquid grease solidifies on exposure to air to form a strongly-adhesive grease unaffected by heat or moisture. Free sample upon request.

McGlaughlin Oil Co., Columbus, Ohio.

Circle No. 203 on Reader Service Card

Helical gear system

Helicon uses a skew axis helical pinion in combination with a conjugate disc gear. The gears may be hobbed, cast of metal or plastic, or sintered metal. Pinions may be rolled, milled, chased or on higher number of teeth, hobbed. Ratios range from 3:1 to 400:1. According to material,

new Wood's selector charts simplify timing drive design

Now you can shelve the slide rule when you figure a timing belt drive installation. Engineers at T. B. Wood's Sons Company have developed a simplified design method that produces the right drive answers with almost no calculations.

This new method is contained in five easy-to-understand Selector Charts covering all timing belts from "extra light" to "double extra heavy." These new Selector Charts are a Wood's exclusive. For your free set, write for Bulletin 21103.

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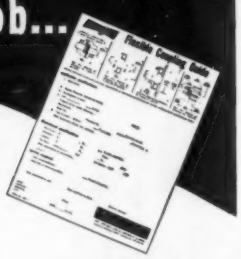
To Get The Flexible Coupling Best Suited For Your Job...

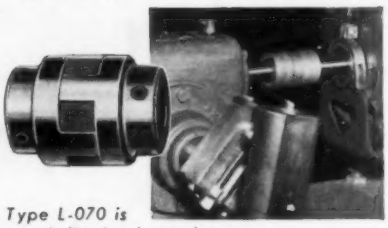
use the **Lovejoy**

Flexible Coupling Guide

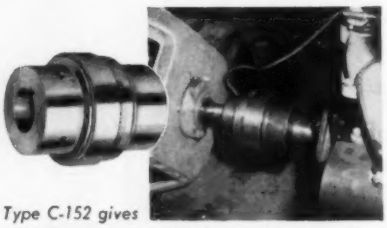


Save time, money and mistakes, insure trouble-free performance . . . by using the Lovejoy Flexible Coupling Guide. You'll get the exact type and size for your particular application —*plus all these Lovejoy features:*

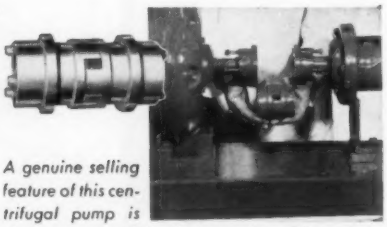
- No lubrication required.
- Simple, rugged construction—few parts, no intricate mechanisms.
- No wear on metal parts—the load is transmitted through cushions only.
- Double-life cushions—one half the cushions act as idlers, except on reversing loads. Thus, a quick interchange provides a new set of cushions.
- Cushions engineered to load and service conditions.
- A maintenance-free coupling that is completely machined for ease and speed of alignment.



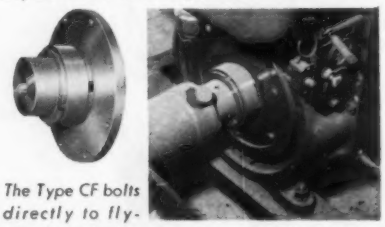
Type L-070 is exactly fitted to the requirements of this gear pump.



Type C-152 gives maintenance and trouble-free performance in a portable power unit.



A genuine selling feature of this centrifugal pump is the spacer type RRL which permits quick, easy disassembly without disturbing piping. (Courtesy Dean Brothers Pumps, Inc.)



The Type CF bolts directly to flywheel, reducing component requirements, cutting assembly time and providing a more compact unit.

● **Act now! Send for your Flexible Coupling Guide today.**

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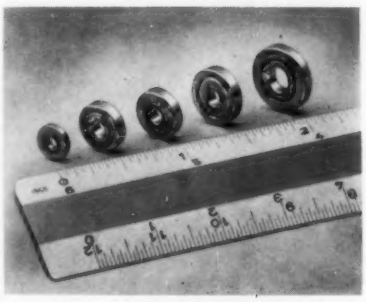
the face gear can be made in a wide range of diameters for light or heavy loads, including hardened steel pinions and gears for power transmission. Advantages of the system are insensitivity to mounting errors and low cost.

Spiroid Div., Illinois Tool Works, Chicago, Ill.

Circle No. 204 on Reader Service Card

Thin bearings

Developed for synchros, bearings feature a high outside diameter/width ratio for through-bore and through-ground housings. The nar-



row width of the bearings makes possible the use of longer stators and rotors in synchros and small motors, increasing power but not size. Made to ABEC class 7 tolerances, they are stocked in 9 sizes with ODs from .2750 in. to .5000 in. and bores from .0937 in. to .1875 in. Standard material for balls and rings is 440C stainless steel. Series includes open single and double-shielded bearings.

Miniature Precision Bearings, Inc., Keene, N. H.

Circle No. 205 on Reader Service Card

Rubber oiler

A Buna N rubber oiler is fastened onto a casting or sheet metal by cement. Advantages claimed for this material and design are lower costs, no sharp edges, and less critical mounting hole requirements.

Eynon-Dakin Co., Detroit, Mich.

Circle No. 206 on Reader Service Card

Integral hp ac-dc motors

This line is available in ratings through 7½ hp in 1800 and 1200 rpm speeds. A standard open ventilated motor is packaged with 4 silicon rectifiers in a bridge circuit

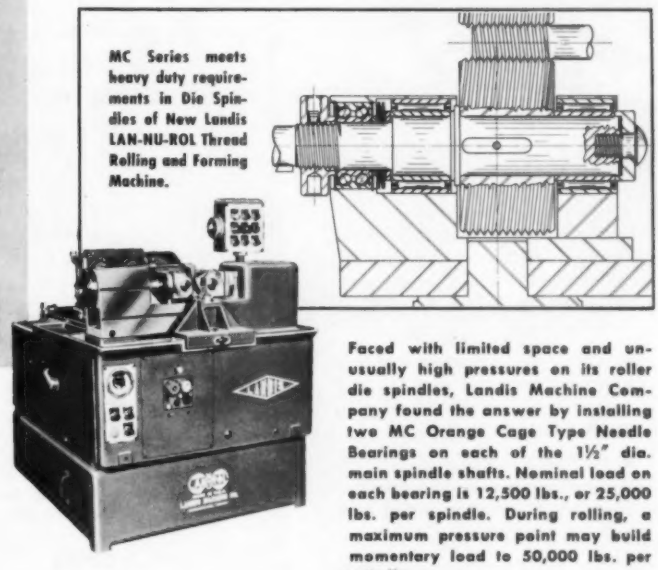
Announcing 2 NEW SERIES OF ORANGE *Cage Type* NEEDLE BEARINGS

for applications requiring maximum radial capacity

These two new series of needle bearings fill a much-needed place in bearing design for heavy duty service. Both series have relieved-end rollers to minimize high stress concentrations and fatigue at the corners. The rollers are of the square end type for maximum effective roller length. Each roller is retained in pockets of tubular steel cages to maintain alignment while running. Write for engineering specifications.

MC SERIES

The MC Series is interchangeable dimensionally with standard needle bearings, but uses larger diameter and longer rollers for increased load capacity. It provides an extremely compact, high-load, even-running bearing for heavy duty service. Sizes now in production for ½" to 2" shaft diameters.



MC Series meets heavy duty requirements in Die Spindles of New Landis LAN-NU-ROL Thread Rolling and Forming Machine.

Faced with limited space and unusually high pressures on its roller die spindles, Landis Machine Company found the answer by installing two MC Orange Cage Type Needle Bearings on each of the 1½" dia. main spindle shafts. Nominal load on each bearing is 12,500 lbs., or 25,000 lbs. per spindle. During rolling, a maximum pressure point may build momentary load to 50,000 lbs. per spindle.

HS SERIES

This is an entirely new series of bearings made in inch sizes dimensionally between standard needle bearings and conventional cylindrical roller bearings. The HS Series is heavier-sectioned than the MC Series and provides higher load capacity for applications where space is available. Sizes now in production for 1" to 2" shaft diameters. Additional sizes under development.

ORANGE
ROLLER BEARINGS

ORANGE ROLLER BEARING CO., Inc.
552 Main Street, Orange, N. J.

Needle Bearings — Staggered Roller Bearings
Journal Roller Bearings — Thrust Roller Bearings
Cam Followers

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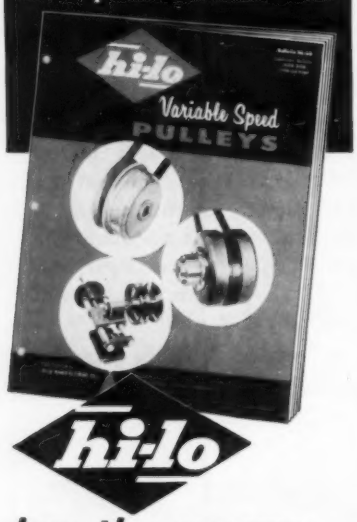
Whatever Your Vari-Speed Requirement...



hi-lo

has the answer...

- Variable speed pulleys with exclusive cam and cam follower feature that assures constant speed regardless of load variations. Ratios to 2.6 to 1. Fractional to 5 hp.
- Wide V-belt variable speed pulleys with cam and cam follower feature as above. Speed ratios to 3 to 1. Fractional to 5 hp.
- Hi-Ratio variable speed pulleys for economy and exceptional efficiency at speed ratios as high as 7 to 1.
- Dual ratio compound drives to provide a compact unit for obtaining speed ranges not possible with a single pulley.
- Motor bases in a full range of types and sizes: adjustable, tilting and movable countershaft. Also motor frames.
- Wide V-belt sheaves and wide variable speed belts, sizes from .087 to 14.

You'll find the answer to any vari-speed application in Hi-Lo's complete line. Ask for recommendations on your requirement. Request Bulletin HL-60.

Manufactured By HI-LO MANUFACTURING COMPANY
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West Lake St.
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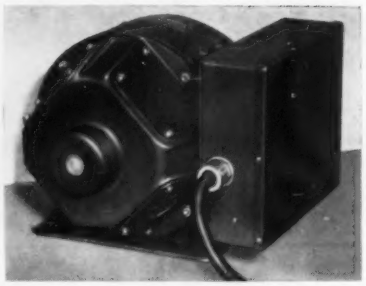


which does not need reconnecting for each type of current. For most uses, difference in motor output for each current type is negligible. Rectifiers are protected from overloading with quick-blow fuses and by using series or compound-wound fields to place inductance in series with the armature.

Industrial Motor Div., Robbins & Myers, Inc., Springfield, Ohio.

Circle No. 207 on Reader Service Card

Hydraulic couplings

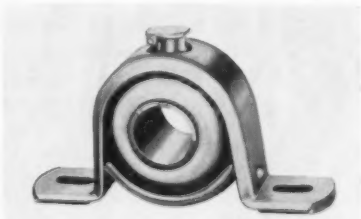
Design features of heavy-duty variable speed couplings include double thrust bearings, large low-stressed shafting, separate oil filters for the bearings and simplified gear drive for the oil pump. A large oil supply pump assures quick response to speed change signals and improved oil flow passages reduce flow restrictions. Present applications are draft fan drives for steam boilers and other heavy-duty fan jobs.

National Supply Co., Pittsburgh, Pa.

Circle No. 208 on Reader Service Card

Cushioned bearing

The bearing ball unit in this line of pillow block bearings is encircled with a Neoprene cushion to insulate it from the mounting. For applications needing noise and vibration suppression. Unit is self-aligning, for shaft sizes from 3/4 in. to 1 1/4 in.



Triangle Mfg. Co., Oshkosh, Wis.

Circle No. 209 on Reader Service Card

Gearless speed reducer

A ball transmission type speed reducer operates within a 4-step, V-type cone pulley in a 3-to-1 reduction or locked in 1-to-1 direct drive.

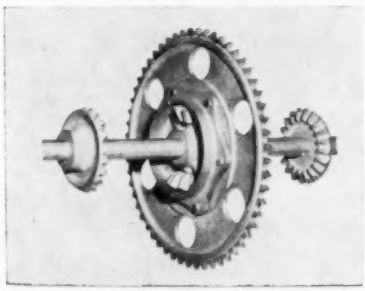
Adjustment of torque-selector knob changes friction force on balls to permit slippage when torque exceeds setting. There are two sizes: 5-in. dia. 4-step pulley for 1/2 to 5/8 in. shafts, 6-in. dia. 4-step pulley for 1/2 to 5/8 in. shafts.

Torque-Master Div., Roberts Aircraft Engine Co., Burbank, Calif.

Circle No. 210 on Reader Service Card

Small differential

A differential measuring 5 1/8 in. by 3 3/8 in. is for drives up to 6 hp. Designed for mowers and small vehicles,



it gives equal power to both wheels, permitting easy and shortened turning. Action can be either forward or reverse. Axle bores are from 1/2 in. to 1 in. in diameter, with 3/16 in. keyways on bores from 1/2 in. to 3/4 in.

Cizek Mfg. & Distributing Co., Inc., Clutier, Iowa.

Circle No. 211 on Reader Service Card

Gasket material

Made of Buna N latex combined with rag paper stock, it has a high tensile strength in both machine and cross machine directions. A special release coating prevents gasket sticking.

Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Circle No. 212 on Reader Service Card

Miniature clutch-brake

Both clutch and brake are magnetically set in this combination. Current to the clutch magnet cuts off the brake magnet and vice versa. There is also a neutral position for free wheeling when current is turned off

both magnets. Unit is available in any dc voltage to 90 v., has a 1.55 current rating. Torque on both clutch and brake is 8 lb.-in. Shafts and bearing mounts are on a single cast mounting bracket to eliminate alignment problems. It comes with a foot mounting for easy adaptability.

Stearns Electric Corp., Milwaukee, Wis.

Circle No. 225 on Reader Service Card

Molded V-belt

Cord members are molded into an arch, resulting in increased sidewall pressure, a more uniform pitch and better grip. Known as the CX V-belt,

it has fully-molded and jacketed construction said to eliminate flex-cracking and to greatly increase fatigue resistance. Fabric jacketing reduces cross sectional distortion and resists changes in effective length.

Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.

Circle No. 226 on Reader Service Card

FROM ¼ HORSEPOWER—

ACTUAL SIZE NO. 25, ¼" PITCH

Average Tensile Strength of 925 lbs.

TO

1000 HORSEPOWER

Average Tensile Strength 95,000 lbs.

ACTUAL SIZE NO. 200
2½" PITCH

ACME Roller Chain applications range from fractional horsepower drives to those in excess of a thousand horsepower.

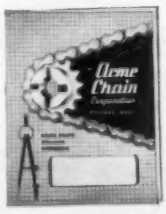
The ACME ¼" pitch roller chain, weighing less than two ounces per foot, is used on such intricate machines as microfilm projectors, electronic controls and many other similar applications.

ACME large pitch chains of multiple strands, weighing 40 to 50 pounds per foot, are available for heavy duty service on heavy machinery.

Use ACME Roller Chain Drives and be assured of these inherent characteristics:

1 High efficiency throughout the life of drive.
2 Constant speed ratio between the driving and driven shaft.
3 Minimum loads on shaft bearings.
4 Sufficient elasticity to absorb shock loads.
5 Maximum life expectancy.
6 Large speed ratios — up to, and including 6 to 1.

Your local Distributor can supply you promptly with ACME Roller Chains in 12 standard sizes, from ¼" pitch, ⅛" width to 2½" pitch, 1½" width.



Write Dept. 28-L for new 100-page illustrated technical catalog including new engineering section showing 36 methods of chain adjustments.

Acme Chain Corporation
HOLYOKE MASSACHUSETTS

COMPLETE LINE OF ROLLER CHAINS AND SPROCKETS • DOUBLE PITCH CONVEYOR CHAINS • STAINLESS STEEL CHAINS • CABLE CHAINS • FLEXIBLE COUPLINGS • STANDARD AND SPECIAL ATTACHMENTS

Circle No. 1 on Reader Service Card

Thin section bearings

Bearings in 90 sizes with bores from 4 to 12 in. Called the CP series, they use Conrad deep-groove ball radial construction and a new one-piece bronze snap-over separator. Sizes

range from ¼ in. to 1 in. width and cross section. Races are high carbon chromium bearing steel hardened to Rockwell C 58 to 62. Can also be made to order with other metals or with coil spring separators for uniform torque characteristics.

Kaydon Engineering Corp., Muskegon, Mich.

Circle No. 213 on Reader Service Card

Worm gear reducers

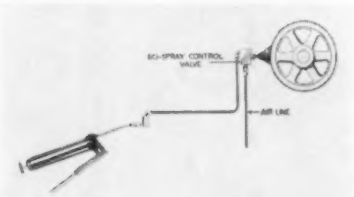
A line of fan-cooled speed reducers offers 25 types and over 135 different sizes. Ratios range from 5:1 to 3600:1 with torque ratings to 135,000 lb.-in. and hp ratings to 150. Lubrication is automatic by a splash system between the oil reservoir and internal channels to the bearings. On the low speed shaft, grease fittings are used. All shaft openings have oil seals. Fan-cooling reduces size while keeping load-carrying capacity.

Link-Belt Co., Chicago, Ill.

Circle No. 214 on Reader Service Card

Spray lubrication system

Consists of a hand grease gun and a control valve connected to a compressed air supply. When gun is pumped, lubricant pressure forces



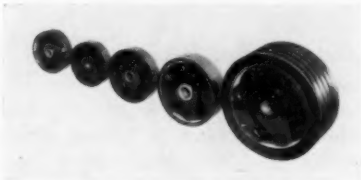
down a spring-loaded piston, opening the air control valve. Air and lubricant under separate pressure are forced through the spray nozzle. Piston returns to its original position when lubricant flow ceases, closing off air supply. System is recommended for inaccessible heavy duty gears.

Farval Div., Eaton Mfg. Co., Cleveland, Ohio.

Circle No. 215 on Reader Service Card

Automatic clutches

A line of automatic clutches for gasoline engines from 1 to 100 hp. Design features sealed ball bearings and improved shoe construction. It



is said to have one-third the parts used in other models, offering greater strength and easy replacement of linings.

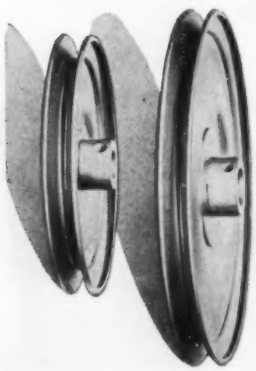
Salsbury Corp., Los Angeles, Calif.

Circle No. 216 on Reader Service Card

Cut Production Costs with NAGEL-CHASE

FHP SINGLE GROOVE V-BELT PULLEYS

- Sturdy welded, pressed steel construction
- Light weight design
- Wide range of sizes
- 2.4" to 12" P.D.
- ½" to 1" bore



Nagel-Chase specializes in the economical production of sturdy light weight fractional H.P. V-Belt pulleys for original equipment manufacturers. Because of specialized equipment and tools for a wide range of sizes, manufacturers can cut tooling and production costs on standard sizes of pulleys by using these standard sizes. Available for a wide range of pitch diameters for both "A" and "B" section V-Belts.

For complete specification write for catalog circular today.

***The* NAGEL-CHASE MANUFACTURING CO.**

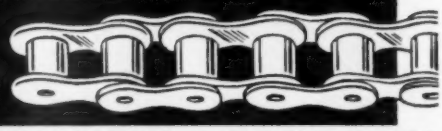
2815 NORTH ASHLAND AVENUE CHICAGO 13, ILL.

Circle No. 30 on Reader Service Card

Available NOW...

FROM A NEW, RELIABLE SOURCE

SIEMAG ROLLER CHAINS



...KNOWN THROUGHOUT THE WORLD FOR DURABLE, EFFICIENT SERVICE

SIEMAG ROLLER CHAINS—in both COTTERED and RIVETED types—are available promptly from Unitech Products, Inc. Pitches range from ⅜" to 2½"... obtainable in single and multiple widths... special types to meet special needs.

All Siemag Roller Chains are manufactured to ASA Standards, easily enabling their use in new equipment or as highly suitable replacements. For complete information on the delivery and advantageous price of these high-quality chains, write, wire, or phone today.

UNITECH *Products Inc.* WOrth 4-3365

50 CHURCH STREET NEW YORK 7, N. Y.

National Distributors for

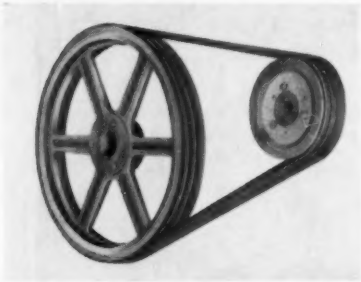
SIEMAG FEINMECHANISCHE WERKE GMBH

EISERFELD/SIEG, GERMANY

Circle No. 40 on Reader Service Card

Compact belt drives

Known as High Cap Wedge drives, this line is designed for greater hp capacity with less bulk. Belts are narrower than normal V-belts, but with equal sidewall contact. This



makes possible sheaves of smaller face width and diameter and shorter center distances. Bushings are quick-detachable type. Larger sheaves have H-beam spokes for greater strength with less weight.

Fort Worth Steel & Machinery Co., Fort Worth, Tex.

Circle No. 217 on Reader Service Card

Anti-weld grease

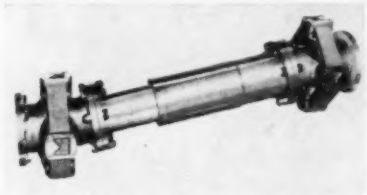
Called Anderol L-751, it's a mixture of a thermally stable silicone oil with a solid lubricant blended to a medium soft grease. Thermal stability and anti-seize properties are good for temperatures from 400 to 600 F. Grease comes in 35, 100, and 400 lb. drums, 1 and 5 lb. cans, and 14 oz. cartridges.

Lehigh Chemical Co., Chestertown, Md.

Circle No. 218 on Reader Service Card

Universal drive

Identified as Torq-Ring 500, an addition to a line of large universal drives is rated for over 2000 input hp at 1000 rpm. Open-end bearing



design is self purging when lubricated. Mechanical blocks prevent field misassembly. A split spline in the drive allows 8 in. of play for faster installation. All components are dynamically balanced.

Koelling Corp., Dallas, Tex.

Circle No. 219 on Reader Service Card

your distributor has BOND power transmission equipment for your job — in stock!

Your problem power transmission component may already have been engineered by Charles Bond Company! Power transmission users the country over find it saves time and money to check with Bond first.

Time and again a review of the facts reveals that proven Bond *stock* components solve the problem without resorting to a new engineering approach, expensive dies and costly delay.

Bond's more than 60 years of manufacturing power transmission equipment has made it routine to specify our components for a great variety of design applications.

Check with your nearest Bond distributor, or contact Charles Bond Company for all your power transmission applications for:

OFF THE DRAWING BOARD
OR OFF THE SHELF?
CHECK WITH BOND!

Carried in stock by DISTRIBUTORS IN PRINCIPAL CITIES

Write for free catalog No. 100

Bond CHARLES BOND COMPANY

617-23 ARCH STREET • PHILADELPHIA 6, PENNSYLVANIA

Circle No. 5 on Reader Service Card

Combination gear drive

Designed for dual engine-motor driven vertical pumps, this right angle gear drive is made in sizes from 15 to 200 hp with either hollow or solid shafts. Installation can be simplified by use of flexible shafting or couplings between engine and gear drive.

Johnson Gear & Mfg. Co., Berkley, Calif.

Circle No. 220 on Reader Service Card

Lagged wing pulley

Strips of rubber lagging are fastened to the exterior edge of each wing in a U-shaped steel casing. These grip the belt tightly when compressed and spring back when contact is broken. This action automatically cleans the underside of the belt, eliminating pulley cleaning shutdowns and increasing belt life. Pulley is mainly for conveyor systems handling sticky materials.

Van Gorp Mfg., Inc., Pella, Iowa.

Circle No. 221 on Reader Service Card

New-frame-size motors

Extension in frame size covers motors, generators, and motor generators. Four NEMA frame sizes-584A, 585A, 683A, and 684A—results in 28 new dripproof motor ratings and 14 dripproof generator ratings.

General Electric Co., Schenectady, N. Y.

Circle No. 222 on Reader Service Card

Variable speed belting

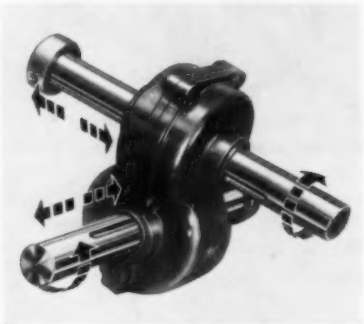
Link-type construction permits quick assembly of any required length and extreme longitudinal flexibility. Increased plies per link give high crosswise rigidity and resistance to compression. Top widths from 7/8 in. to 4 in. for use on V-pulleys.

Brammer Corp., New York, N. Y.

Circle No. 223 on Reader Service Card

Floating gear drive

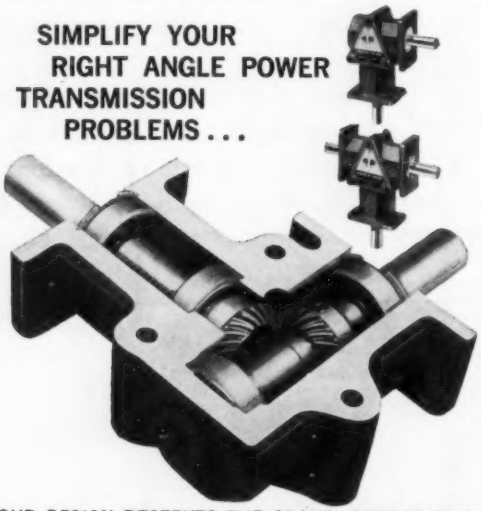
No need for separate couplings or supports on this right-angle drive. It's installed by assembling the gears around the shafts. A floating gear system permits self-alignment and automatic adjustment on the driving and driven shafts. Ratio is 1:1.



Tol-O-Matic, Inc., Minneapolis, Minn.

Circle No. 224 on Reader Service Card

SIMPLIFY YOUR RIGHT ANGLE POWER TRANSMISSION PROBLEMS . . .



YOUR DESIGN **DESERVES** THE CROWN GEAR "PACKAGE".

• Totally enclosed Aluminum Alloy Housing • 316 Stainless Steel Shafts • Double Sealed Ball Bearings • Hardened Steel, Spiral Bevel Gears • Choice of 4 or 5 Mounting Positions • Ratings from 1/4 through 2 H.P. • 1:1 or 2:1 Ratio optional

Contact your local distributor or write direct for new catalog . . .

CROWN GEAR

320 PARK AVE., WORCESTER 10, MASS.

A Division of Harrington & Richardson, Inc.

Circle No. 10 on Reader Service Card

WHAT'S YOUR PROBLEM?

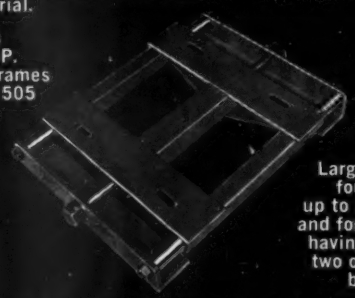
Is it any of the following?

- Diminishing output due to a progressive drop in rpm.
- Too much down-time because of the need for frequent adjustment due to belt stretch.
- Excessive maintenance time and expense.
- Poor belt and bearing life.
- A drive in an inaccessible or isolated location.
- A high-ratio short-center drive.

MOUNTING THE MOTOR ON AN "AUTOMATIC"® BASE MAY PROVE TO BE A SIMPLE AND ECONOMICAL SOLUTION

Motor mounting position and direction of pulley rotation are immaterial.

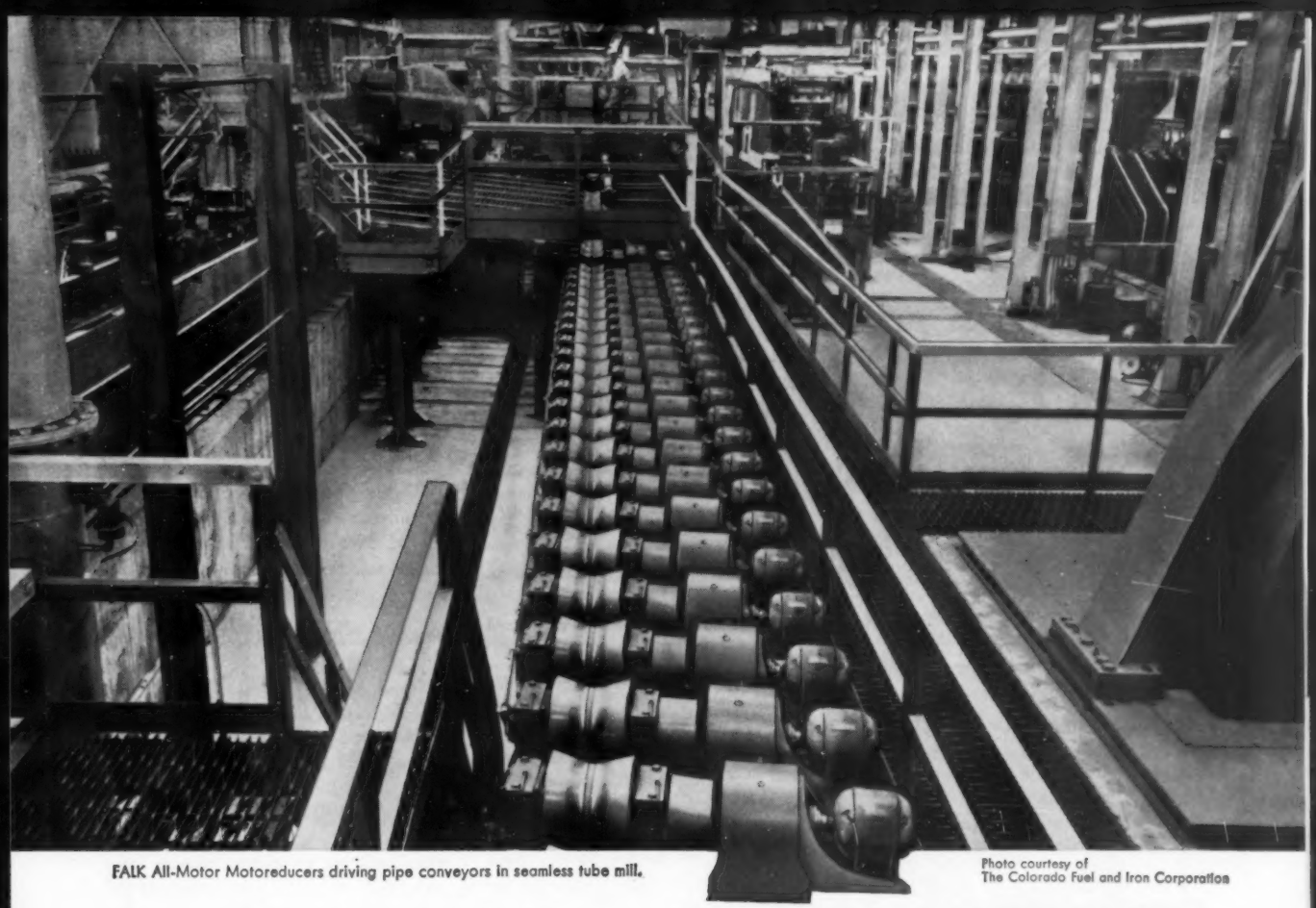
Stock Sizes
1/4 to 125 HP.
for NEMA frames
56 through 505
and 445-U



Larger Sizes for motors up to 500 HP. and for motors having one or two outboard bearings.

AUTOMATIC MOTOR BASE CO.
WINDSOR, N. J.

Circle No. 4 on Reader Service Card



FALK All-Motor Motoreducers driving pipe conveyors in seamless tube mill.

Photo courtesy of
The Colorado Fuel and Iron Corporation

You get these "extras" when you buy FALK *all-steel* Motoreducers

1. **Freedom from damaged housings.** The exclusive FALK *all-steel* construction gives full protection from cracked housings or torn-off feet...plus twice the ability of cast iron to maintain vital alignment.

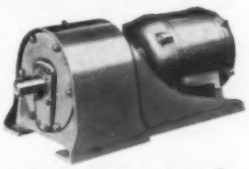
2. **12-15% reserve load-carrying capacity** in the gears, by AGMA standards. The extra-depth, high pressure angle helical gears are another FALK exclusive ...they assure better operation and longer gear life.

3. **Highest known gear efficiency**—98½% per gear train under full load! This means maximum productive work for your power dollar.

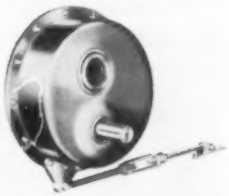
4. **Longer service life**...advanced FALK design makes it possible to machine both bores for each shaft assembly at one time, thus eliminating possible accumulation of tolerances that occurs when individually machined parts are assembled. The result—better alignment of revolving elements that permits units to transmit rated capacity longer.

5. **Standard units to fit your needs.** Integral and All-Motor® Motoreducers are available in horizontal, vertical and right angle types...a type for every use.

Units are available up to 75 hp; output speeds from 780 rpm down to 1.2 rpm. Prompt delivery from factory, warehouse or distributor stocks.
Ask your FALK Representative or Authorized FALK Distributor for *Bulletin 3100.*



THE FALK ALL-MOTOR® MOTOREDUCER
the original All-Motor unit
(Shown) Horizontal concentric model. Also available in right angle and vertical types.



THE ALL-STEEL FALK® SHAFT MOUNTED DRIVE
Proved best for the countless industrial applications where a reducing unit mounting directly on shaft of the driven machine is indicated.
Units from 1/2 to 50 hp. Ratios —4:1, 14:1 or 24:1. Torque capacity up to 41,000 lb-in (in standard units). Prompt shipment from stock. For details, ask for *Bulletin 7100.*

THE FALK CORPORATION, MILWAUKEE 1, WIS.
MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS
Representatives and Distributors in most principal cities
Circle No. 16 on Reader Service Card

FALK
...a good name in industry

LITERATURE *on drives and components*

To get free copies of the following literature, use the Reader Service Cards bound into this issue.

MAGNETIC DRIVE CATALOG . . . covers working principles and performance of permanent magnet drives and gives examples of typical applications. Catalog No. TP-160. *Tormag Products Div.*, Milwaukee, Wis.

Circle No. 301 on Reader Service Card

GEAR BROCHURE . . . shows a complete line of stock and special gears to meet all power drive needs. Bevel, helical, miter, worm and spur gears included, as well as steel racks. *Ohio Gear Co.*, Cleveland, Ohio.

Circle No. 302 on Reader Service Card

PRECISION INSTRUMENT BEARINGS . . . feature a high outside diameter/width ratio. Narrow width of the bearing makes possible longer stators and rotors in synchros and small motors without increasing their size. Bulletin 6002 gives details. *Miniature Precision Bearings, Inc.*, Keene, N. H.

Circle No. 303 on Reader Service Card

ENCAPSULATED MOTORS . . . are 1¼ in. diameter, hysteresis-synchronous ac type which develop 0.75 oz.-in. of torque. Encapsulation is epoxy type. Described in Bulletin 1105. *Globe Industries, Inc.*, Dayton, Ohio.

Circle No. 304 on Reader Service Card

AIR-COOLED TORQUE CONVERTER . . . for smaller engines is completely self-contained and needs no charger pump. A folder gives typical performance curve and a cutaway section. *Clark Equipment Co., Automotive Div.*, Jackson, Mich.

Circle No. 305 on Reader Service Card

GEAR SHAVING . . . and honing are covered in a 16-page booklet 5-60-1B. Describes basic principles, methods and advantages. Includes an application table for selecting shaving machines for external and internal gears. *National Broach and Machine Co.*, Detroit, Mich.

Circle No. 306 on Reader Service Card

OIL SPRAY LUBRICATION . . . system is air-operated and adjustable from a coarse to a very light spray. Cooling effect of evaporating liquid increases possible speeds of cutting tools, high-temperature chains, etc. Details in Report No. 24. *Oil-Rite Corp.*, Manitowoc, Wis.

Circle No. 307 on Reader Service Card

HEAVY-DUTY BALL BEARINGS . . . in metric sizes to 85 mm OD are offered in ABEC-3 and ABEC-5 precision grades. Bearings are radial retainer type and use maximum ball complement for higher load capacities. Catalog 60 gives specifications. *Split Ballbearing Div., MPB, Inc.*, Lebanon, N. H.

Circle No. 308 on Reader Service Card

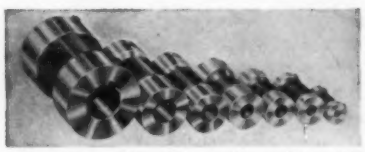
Couplings for Power Transmission

Gear-Grip . . . Actual Size New S-G Coupling

The most revolutionary Flexible Coupling Design Development in a century!

- New available for subfractional, fractional and integral H. P.
- Ability of rubber Flex-Elements to float between captive end fittings distributing load similar to universal joint action.
- Load Ranges—1/12 H.P. through 30 H.P.
- Shaft Sizes—⅛ through 1⅞.
- Specified exact length to design requirements per series.
- Prevention of end thrust among many other design advancements.*

Dyna-Line The finest flexible coupling in single unit construction—specifically designed for fractional H.P.



5R 4R 3R 2R 1R 0R 00R

- Lengths varied to design specifications in each series.
- True Flexibility and Torsional Resilience for quiet, load-plus power transmission without extreme deflection or twist.
- Load ranges—1/15 to 1½ H.P.
- Shaft sizes—3/16" to ¾".
- Lowest O.D. for highest torque capacity.

Write for Catalogs and Technical Bulletins.

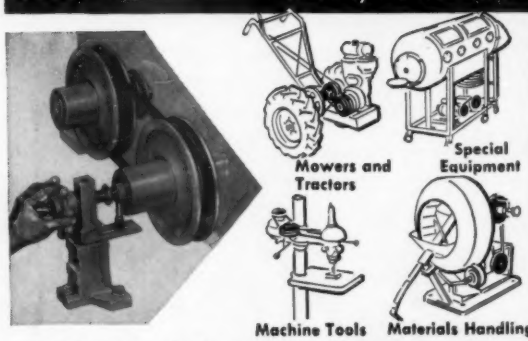
GUARDIAN PRODUCTS CORP. DEPT. PT-460 1215 E. SECOND ST. • MICHIGAN CITY, IND.

Circle No. 21 on Reader Service Card

SPEED SELECTOR

VARIABLE PITCH SHEAVES

Control Speeds on Variety of Machines



Wide Speed Range! Low Cost Sheaves

Speed Selector Sheaves can give your machines or equipment extra wide-range speed control on fixed centers. Efficient, rugged, simple to use — low in cost! Write for Illustrated Bulletin.

CATALOG FREE! WRITE TODAY

SPEED SELECTOR INC.

P. O. BOX 312-P • CHAGRIN FALLS, OHIO

Circle No. 36 on Reader Service Card

FLUID COUPLINGS . . . for OEM applications and package units with a wide variety of input-output combinations are covered in Bulletin 144-E. How couplings perform with internal combustion and electric motors is discussed. *Twin Disc Clutch Co.*, Racine, Wis.

Circle No. 309 on Reader Service Card

FRICTION MATERIAL APPLICATIONS . . . for brakes and clutches are listed in a 2-page check sheet. Sheet enables manufacturer to suggest right material for the job. *Raybestos-Manhattan, Inc.*, Bridgeport, Conn.

Circle No. 310 on Reader Service Card

COOL MOTOR . . . is obtained by having vents below the terminal box as well as in the end bells. This is a feature of a line of open dripproof ac motors detailed in literature. *Brook Motor Co.*, Chicago, Ill.

Circle No. 311 on Reader Service Card

MOTOR ALTERNATORS . . . and generators for ac-ac and ac-dc conversion are specified in Bulletins RPAA-5909 and RPAD 5913. Charts show recommended system controls and accessories. *Electric Speciality Co.*, Stamford, Conn.

Circle No. 312 on Reader Service Card

BRONZE . . . for bearings and bushings is highlighted in a 16-page brochure. Facilities, specifications and formulas for running clearances are included. *American Crucible Products Co.*, Lorain, Ohio.

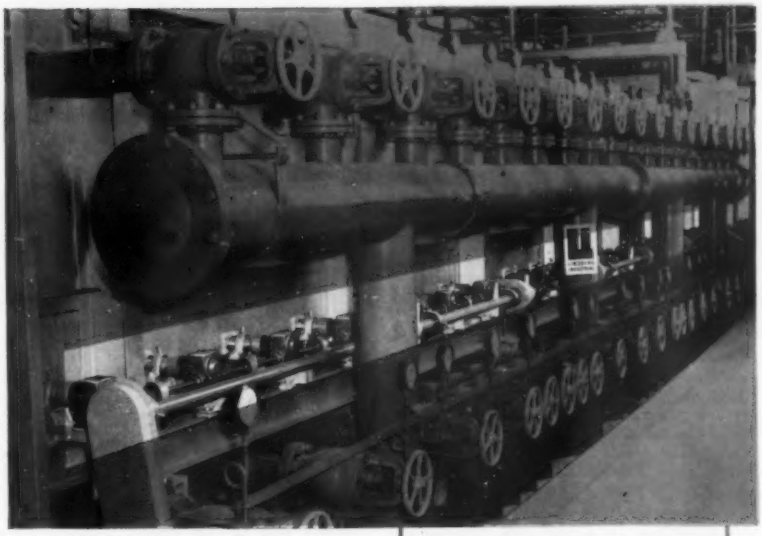
Circle No. 313 on Reader Service Card

GEAR TOOTH COUNTER . . . for users of fine pitch gears gives a direct reading of pitch and number of teeth by means of a base scale and an adjustable sine bar. *PIC Design Corp.*, East Rockaway, N. Y.

Circle No. 314 on Reader Service Card

WORM GEAR REDUCERS . . . in 25 types and over 135 sizes with ratios from 5:1 to 3600:1, torque ratings to 135,000 lb-in., and hp ratings to 150. Book 2824 has 66 pages of selection data, rating tables and illustrated applications. *Link-Belt Co.*, Chicago, Ill.

Circle No. 315 on Reader Service Card



Lindberg Roller Hearth Solution Treating Furnace, showing some of the 101 Winsmith Model 2CB Reducers which drive the rolls. An additional Model 7CT is also installed. The heating chamber of this furnace is 100 feet long with 40 feet of quench chamber.

LINDBERG ENGINEERING USES 102 WINSMITH SPEED REDUCERS *on their Roller Hearth Furnaces*

LINDBERG ENGINEERING COMPANY of Chicago is a leading manufacturer of heat treating furnaces. When they designed this one to handle 4,000 lbs. of aluminum extrusions per hour, specifications called for 101 speed reducers to drive the rollers. They selected Winsmith for compact size, rating and their record of past performance. Lindberg is a long-time Winsmith customer. They describe the relationship this way..."We have used Winsmith Reducers for many years and have found their reliability and ruggedness ideal for use with our heat treating furnaces."

Lindberg Engineering is another one of the leading American manufacturers who specify Winsmith Speed Reducers for most applications from 1/100 to 85 hp.—in ratios from 1.1:1 through 50,000:1.

WINSMITH SPEED REDUCERS

WRITE TODAY for complete selection information and engineering data. You'll see for yourself why it pays to standardize on Winsmith.

MEMBER OF AGMA

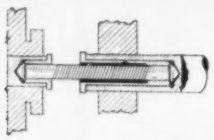
WINSMITH, INC.

28 Sixth Street, Springville, (Erie County), N. Y.

Circle No. 43 on Reader Service Card

Circle No. 37 on Reader Service Card

Flexible Shaft Coupling For Power Transmission



Coupling is used for the transmission of power or control of movement between parts located close together in a piece of equipment. It is not a separate type of flexible shaft but an added application.

The coupling can be composed of either mono-directional or bi-directional flexible shafting although the latter is generally used due to the added advantage of its ability to rotate both clockwise and counterclockwise. Generally used between two units a few inches apart, coupling transmits power between any two parts regardless of their relative positions.

For example, the diagram above shows an advantage in using small lengths of flexible shafting in a coupling application. Although the drive end and the driven end are not exactly in line, the coupling compensates for the difference in alignment between the two.

Many manufacturers use flexible shaft coupling even where parts may be connected by solid shafts because of the savings realized in the initial and the maintenance costs as well as in time and labor.

For complete information on how flexible shaft couplings may help improve your product design, write F. W. Stewart Corporation, 4311-13. Ravenswood Avenue, Chicago 13, Illinois.

LITERATURE *continued*

COTTON CLEANER DRIVE . . . consists of two grooved sheaves and a mating nylon-faced neoprene belt reinforced by helically wound steel cables. Drive is said to eliminate choke-ups. Bulletin 16103 gives details. *T. B. Wood's Sons Co.*, Chambersburg, Pa.

Circle No. 316 on Reader Service Card

TOOL MOTORS . . . ¾, 1, and 1½ hp ratings are claimed to provide 200% capacitor start torque with 360° positioning. Shaft centerline to base dimension is 1¾ in. Catalog sheet gives details. *Franklin Electric Co., Inc.*, Bluffton, Ind.

Circle No. 317 on Reader Service Card

TINY BALL BEARINGS . . . Catalog 2-E-1 covers dimensions, load factors, ball sizes, and weights of sealed and open radial, flanged radial and pivot type miniature ball bearings. A feature is the listing of other manufacturers' catalog numbers. *Landis & Gyr, Inc.*, New York, N. Y.

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VARIABLE SPEED PULLEYS . . . dimensions and specifications are covered in 24-page Catalog No. 600, including 3 new series. Also has information on companion sheaves, belts, adjustable motor bases, and remote controls. *Gerbing Mfg. Co.*, Elgin, Ill.

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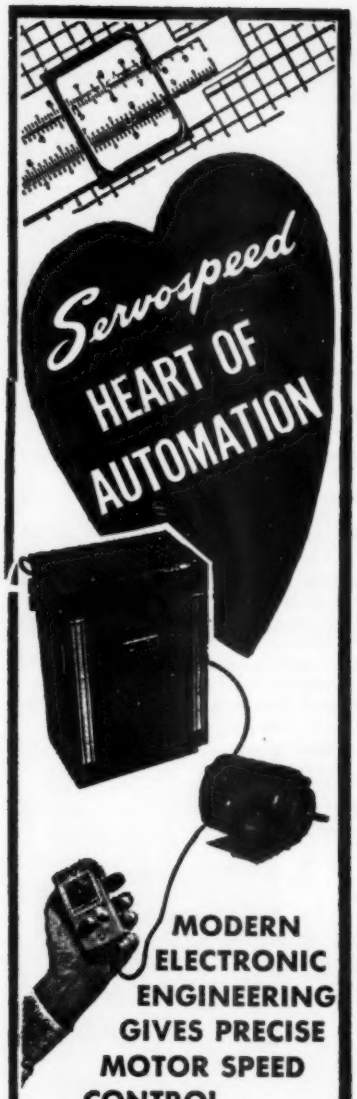

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POWER TRANSMISSION DESIGN

JUNE 1960

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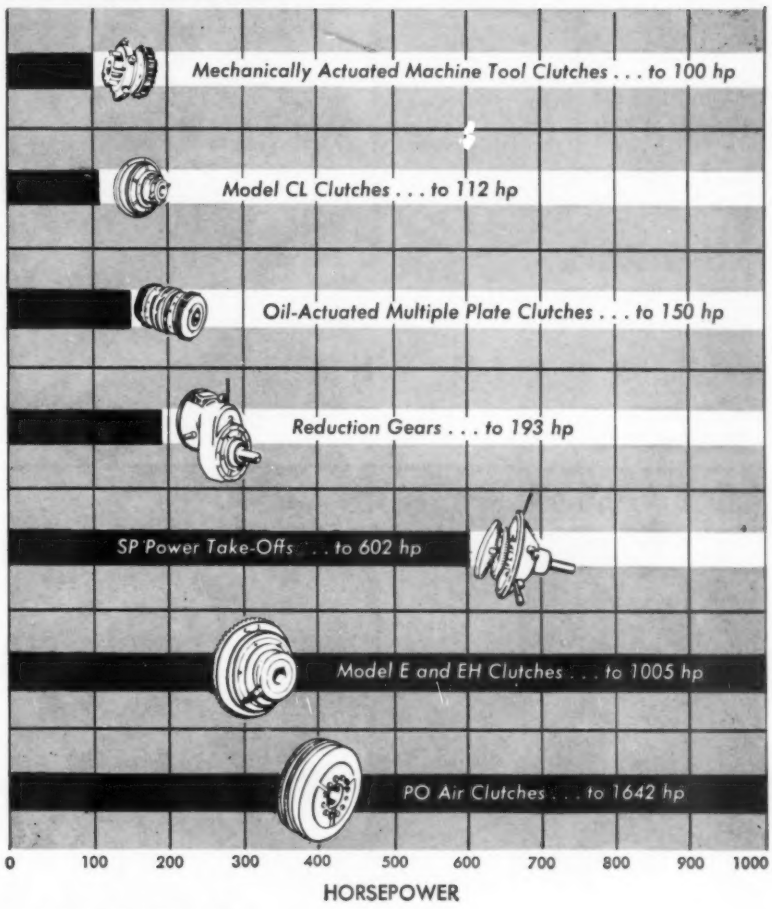
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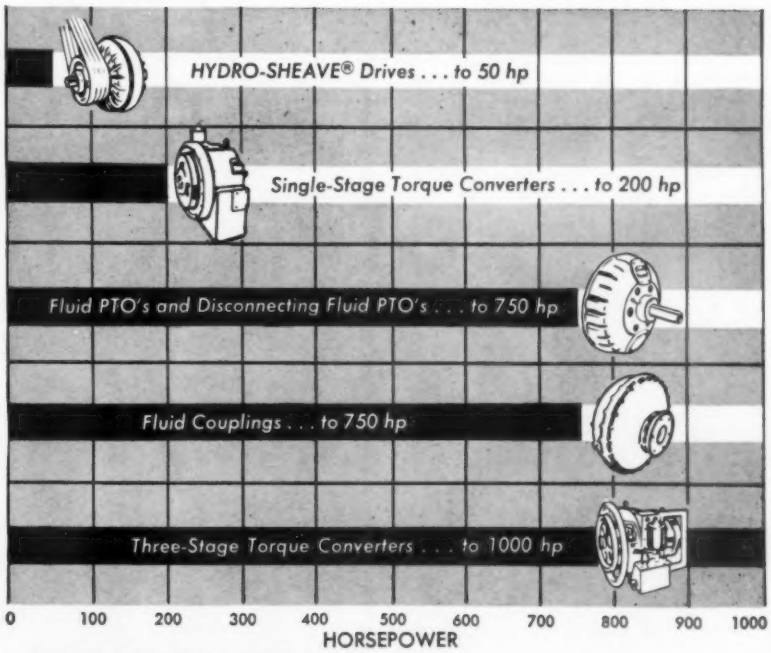
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